THE ECONOMIC AND ENVIRONMENTAL EFFECTS OF LOCAL BUS SERVICE DEREGULATION IN BRITAIN

VOLUME II: APPENDICES

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I certify that this thesis is the true and accurate record of the thesis approved by the examiners.

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APPENDIX 1

Legislative and Structural Changes in Local Bus Services 1947-1985

1.1 The Transport Act 1947

A key factor in Labour's sweeping general election victory of 1945 was its commitment to nationalisation (Cole, 1948). The aim of transport nationalisation under the 1947 Transport Act was "to secure the provision of an efficient, adequate, economical and properly integrated system of public inland transport and port facilities." The Act set up the British Transport Commission (BTC) in which ownership of the nationalised transport properties was vested. The operation of the transport system was the responsibility of five subordinate Executives, of which the Road Transport Executive controlled the road holdings. This was an extensive task, and in 1949 the Road Passenger Executive was formed to take over responsibility for passenger services. Since railway companies were vested in the BTC, the Commission acquired a significant interest in the bus industry via their shareholdings in the bus companies. On 1 January 1948 the BTC purchased the road passenger interests of Thomas Tilling Limited, and on 1 April those of the Scottish Motor Traction Company. Although agreement could not be reached with the British Electric Traction group, which remained under private control, a large minority of its shares were under public ownership. By 1952, out of a total of nearly 67,000 buses, the BTC had control over some 14,000 vehicles operating in all areas of Britain (Thomson and Hunter, 1973).

Part IV of the Act contained provisions for the introduction of area schemes under which regional bodies would decide on matters such as ownership, service provision and the degree of integration between road and rail undertakings. These bodies would not be subject to the licensing controls of the Traffic Commissioners. Implementation of these provisions would have been "the biggest move towards transport integration under the 1947 Act" (Thomson and Hunter, *op. cit.*, p.269). Although plans to introduce the area

schemes were drawn up, the Conservative general election victory in 1951 prevented their implementation. Opposition to the scheme also came from some municipal undertakings reluctant to lose control over services: one example was Newcastle, which was under a Labour-controlled authority. The Road Passenger Executive, which had been given the task of providing detailed plans for the area schemes, was disbanded by the Labour Government prior to the 1951 election.

1.2 The Transport Acts of 1953, 1960 and 1962.

Following the 1952 Conservative White Paper on Transport, the Transport Act 1953 repealed the provisions for area schemes in the 1947 Act and reinvested the Traffic Commissioners with their former powers and duties. BTC was no longer allowed to purchase passenger transport facilities, except with the consent of the Minister of Transport, and the Minister was given powers to order the divestiture of BTC holdings in road passenger transport. These powers were never exercised, one reason being the report of the Thesiger Committee (1953) which had been set up to enquire into the working of the 1930 licensing system. The remit of the Committee was to examine legal and administrative questions, however, rather than the economic inefficiencies of the system. The Committee concluded that there was nothing wrong with the system, that it had been "remarkably successful" in facilitating widespread cross-subsidisation, and rejected the idea of easier entry into the bus industry. This was in contrast to the road haulage sector, where the 1953 Act attempted to reduce entry barriers. This marked the beginning of a differential policy towards the road passenger and road haulage sectors, the former under protective control and the latter subject to increased competition. The Act also marked the end of the nationally integrated transport planning approach embodied in the 1947 Transport Act:

"With the 1953 Transport Act, transport planning at a national level effectively ceased and has never returned. Under the Act, the British Transport Commission took on a totally different form. It became little more than an umbrella organisation to run the

transport services that were in too bad a state to have private buyers."

(Hamilton and Potter, 1985, pp. 42-3).

The 1960 Transport Act, as far as road passenger transport was concerned, merely consolidated the previous Transport Acts. Part III defined public service vehicles (PSVs) and contained provisions relating to their operation. The provisions for granting a road service licence, as well as attaching conditions to it, were exactly the same as those in the 1930 Road Traffic Act. One year later the Jack Committee, set up to consider the problems of rural bus services, reported that the system of internal cross-subsidy could no longer be maintained against the background of the decline in demand for rural bus services and recommended, *inter alia*, the use of school buses and post office vehicles (postbuses) for passenger transport in rural areas. The response of the Traffic Commissioners was to allow more experimentation in the provision of rural services and the increased adoption of differential fare scales, as opposed to their previous preference for uniform charges.

It was the financial problems of the railway system that led to the 1962 Transport Act. This marked a complete reversal of the philosophy of the 1947 Act, which was essentially one of administrative integration, by breaking up the BTC into five autonomous transport bodies. The British Railways Board was set up to achieve a break-even target for the railways as soon as possible. Ownership of the bus and coach undertakings was vested in the Transport Holding Company (THC) as from 1st January 1963. It was given the financial objective to act as a "commercial enterprise" and expanded its activities by acquiring additional bus companies, the largest acquisition being that of the British Electric Traction group in March 1968. By this time the THC had acquired control of nearly all the bus companies apart from the local authorities and London. Some idea of this expansion can be gained by considering the number of journeys accounted for by the state (i.e. BTC or THC) undertakings and the private sector bus companies over the period 1962-68: in 1962 the BTC accounted for 41% of these journeys; by 1968 the THC accounted for 80% (Munby, 1978, p. 227).

1.3 Structural Changes in the Bus Industry: a summary

Before moving to a discussion of the provisions and effects of the 1968 Transport Act, it is useful to summarise some of the structural characteristics, and changes thereto, in the bus industry up to this time. Table 1.1 overleaf shows the importance of the stage carriage service sector in the industry, where a stage carriage service (now known as a local service) is one that operates to a fixed timetable, carries passengers at separate fares, and is not an express service. This type of service is short distance, serving local requirements. Although stage service receipts increased in current terms from 1959 to 1969, after adjusting for inflation using the consumers' expenditure price index they actually fell by 7.85%. The express and contract hire sectors, however, did not follow this trend and managed to increase their revenue in real terms by 22.3% and 35.7% respectively. An express service is one that operates to a fixed timetable and carries passengers at separate fares, where the fare was not less than 5 pence prior to 8 August 1971 (later increased to 11 pence from 9 August 1971 to 24 October 1977, and 21 pence thereafter). A separate road service licence is required for each individual stage or express service. The minimum fare stipulation implies that express services are longer distance, serving mostly inter-urban requirements. The performance of the express sector was mainly because of rising rail fares and improvements in the inter-urban road network.

Excursions and tours do not necessarily run to a fixed timetable, but may vary according to weather or demand conditions. According to the fare charged, they are licensed as either stage or express (usually express) services. In general, operators must charge the return fare for excursions and tours. A road service licence may cover a group of excursions or tours from any one starting point. All services that do not require a road service licence are classified into the contract (and private) hire sector. Contract hire covers those services provided on a regular basis for particular groups of people such as schoolchildren and company employees. Private hire covers the remaining bus and coach services.

Table 1.1: The bus industry by type of service 1959-69

	Passenger Journeys (million)		Bus Mileage (million)		Receipts (£ million)	
	1959	1969	1959	1969	1959	1969
Stage service	13,552	9,323	1,956	1,672	262	341
Express	65	71	102	119	11	19
Excursions and Tours	38	32	68	62	8	12
Contract hire	282	397	241	358	24	46
Total	13,937	9,823	2,367	2,211	305	418

Source: Passenger Transport in Great Britain, 1969, Tables 37, 39, 41, from Thomson and Hunter, 1973, p. 274.

Table 1.2 below shows the significance of the larger operators in the bus industry, and a clear trend towards increasing concentration for the period 1932 to 1952. The largest (200+) operators formed less than 0.5% of total operators in 1932, but ran 38% of the total number of buses. By 1968 these figures were 1.3% and 56.7% respectively. Exceptionally, W. Alexander & Son, one of the Scottish Bus Group's largest companies, was split into three for the purpose of increasing efficiency in 1961. The trend towards larger scale operating units has generated much research on whether economies of scale exist in the bus industry, although the consensus appears to be that economies of scale in the bus industry are limited.

Table 1.2: Size of bus operators

Number of Buses	1932		1952		1968	
	Operators	Buses	Operators	Buses	Operators	Buses
1 - 9	5,949	13,566	4,443	13,639	4,430	12,704
10 - 99	423	10,735	696	15,069	647	14,934
100 - 199	29	4,177	38	5,283	36	4,976
200 +	31	17,752	62	32,805	67	42,653
Total	6,432	46,230	5,239	66,796	5,180	75,267

Source: Annual Reports of the Traffic Commissioners, from Thomson and Hunter, 1973, p.275.

1.4 The Transport Act 1968

Prior to the 1964 general election the Labour Party manifesto had promised to develop a national plan for transport, and also stressed the importance of public transport in the journey to work and in providing a "reasonable" service for those living in rural areas. The problems of providing rural bus services had been discussed in the Jack Report of 1961, whilst the Buchanan Report of 1963 had discussed the problems posed by the growth of car ownership for cities and their environments. Following its general election victory in 1964 the Labour party published a series of six White Papers on transport which culminated in the Transport Act of 1968. This was an extensive piece of legislation that had a considerable impact on the bus industry. The aims of the Act were explained in the first of the White Papers:

(a) the transport infrastructure and services (rail, road, ports, etc.) must be modernised. Since total resources are limited, this means planning investment as a whole, increasing productivity and developing better criteria to assist choice;

(b) the problem of traffic conditions in towns must be given greater priority. Here again the solution lies in integrated planning. New machinery is needed for the conurbations, where the problem is most acute;

(c) the transport system must take account of the social as well as the economic needs of the country;

(d) public transport must play a key role in solving our transport problems. Publicly owned road and rail services must be integrated on a functional basis.

(Transport Policy White Paper, 1966, Cmnd. 3027, p. 31).

The key theme was that of co-ordination via planning, rather than the nationalisation of the 1947-51 period. In the public transport sector the Act created four Passenger

Transport Authorities (PTAs) to control all the local, publicly owned transport undertakings (including the municipal bus companies) in the West Midlands, Merseyside, South East Lancashire/North East Cheshire (SELNEC) and Tyneside conurbations. The first three were set up towards the end of 1969, whilst Tyneside PTA was set up in January 1970. Their function was to:

"Secure or promote the provision of a properly integrated and efficient system of public transport to meet the needs of that area with due regard to the town planning and traffic and parking policies of the councils of constituent areas and to the economy and safety of operation."

(1968 Transport Act, Section 9, (3)).

The PTAs themselves were supervisory agencies: within each PTA a Passenger Transport Executive (PTE) was formed to provide the professional day-to-day management to implement the decisions of the PTA. The equivalent responsibilities of the Greater London Council and London Transport were set out in the Transport (London) Act 1969. In practice, the PTEs co-ordinated with private bus and coach operators running services within their boundaries.

The structure of the bus and coach industry was changed considerably by the 1968 Act. In March 1968 a combination of imminent legislation and financial problems had persuaded British Electric Traction to sell its interests to the nationalised Transport Holding Company, giving the State a dominant role in the industry (see previous section). The Act created two new holding companies from this enlarged group. In January 1969 the National Bus Company (NBC) was formed to operate services in England and Wales. At the same time, the Scottish Bus Group (SBG) was set up and amalgamated with various shipping and ferry services to form the Scottish Transport Group. On 1 January 1970 the London Transport Executive (LTE) was divested of its Country Bus and Green Line services, which were transferred to the NBC, and the Greater London Council took

over the remaining responsibilities of the LTE. The effects of the 1968 Act on the structure of the bus service industry are summarised in Table 1.3 in the next section.

The NBC and SBG represented public ownership at a national level. By the end of 1970 the NBC owned 53 main operating companies, and the STG seven (following the absorption of David MacBrayne Ltd during 1970). The NBC was organised on the principle of decentralisation, whereby each subsidiary would be given the maximum operating autonomy subject to central control over financial matters. The PTAs were publicly owned but functioned at a local level. Prior to the 1968 Act there were 93 municipally owned undertakings, controlled by local councils via their transport committees. After the 1968 Act the number of these undertakings fell to 68, mainly because of the amalgamation of some of them into the PTAs but also because the NBC took over three of them (Luton, Exeter, Gosport and Fareham) in 1969/70. The PTAs were not only larger than the municipally owned undertakings, but were differentiated in other respects: they controlled the railway commuter lines within their boundaries, and were not subject to the jurisdiction of the Traffic Commissioners.

The 1968 Act also recognised the financial difficulties of the industry by providing four types of financial assistance. The New Bus Grant provided 25% (later increased to 50%) of the capital costs of new buses of approved designs: in particular, it aimed to encourage operators to move towards one-person operation. This grant was finally phased out in 1983. The Fuel Duty Rebate (introduced in 1964) was a refund on the duty estimated to have been paid on fuel used for stage services: the Act increased this rebate to cover all but 10 pence of the duty per gallon. The Infrastructure Grant was a 75% capital grant towards planned programmes of improvement in facilities such as bus stations, depots and control systems.

Section 34 of the 1968 Act had particularly significant effects: it enabled local authorities to make grants to loss-making services where retention of those services was considered essential. This was the start of what has been referred to as the "block revenue support" or "blanket subsidy" system, and it had important repercussions for the provision of rural

services: the Rural Bus Grant was paid to local authorities for the provision, improvement or continuance of a loss-making rural service. This subsidy could be up to 50% of the deficit incurred by the service, provided that its costs were not more than double its revenues. From 1 April 1975 the Infrastructure and Rural Bus Grants were incorporated into the Transport Supplementary Grant. The PTAs, like the shire counties, were empowered to finance approved deficits by a precept on the rates, but as subsidy increased sharply throughout the 1970s this system came under increasing strain.

The 1968 Act also had implications for the system of internal cross-subsidisation that the Traffic Commissioners encouraged under the licensing system introduced in the 1930 Road Traffic Act. Firstly, the Act instructed the NBC to operate as a commercial enterprise and, in September 1970, the NBC instructed its subsidiaries to close loss-making rural services unless the local authority involved was prepared to provide sufficient rural bus grant. Secondly, control of services, many of them profitable, within the boundary of the PTAs was transferred from the NBC to the PTAs. A further transfer took place when two more PTAs were created (South Yorkshire and West Yorkshire) by the Local Government Act 1972. The effect of these changes was to reduce substantially the amount of internal cross-subsidisation practised by the NBC. The Jack Committee had already identified other problems in maintaining internal cross-subsidisation for rural services in its report of 1961.

Finally, the 1968 Act reduced the number of hours which drivers could work, and made some minor exemptions for licensing requirements.

1.5 The Local Government Act 1972

Although the Local Government Act 1972 was concerned mainly with changes to the system of local government, it had important consequences for the bus industry. The reorganisation of local government in England and Wales, which took effect from April 1974, created seven metropolitan counties as part of a two-tier approach to local government. The metropolitan counties were the top-tier, with their constituent districts

forming the lower tier. The boundaries of the pre-existing four English PTAs were adjusted to those of the corresponding metropolitan counties. SELNEC became Greater Manchester and Tyneside became Tyne and Wear. Two further PTAs were created in the South Yorkshire and West Yorkshire metropolitan counties. Strathclyde PTA was formed in June 1973.

The Act empowered all county councils outside the metropolitan county councils to co-ordinate and promote an efficient public transport service and to use subsidy if necessary. Subsequently, the Local Government Act 1974 empowered the county councils to finance this subsidy by including it in their submission for rate support grant from central government. Transport Supplementary Grants (TSGs) could also be applied for in order to meet additional transport expenditure incurred on the basis of local need. Normally, about 70% of approved expenditure under this heading was met by central government (Sutton, 1988). In order to assess these TSG applications, all county councils had to prepare a Transport Policies and Programmes (TPP) document describing their 10-15 year transport objectives and strategy, a 5 year rolling expenditure programme, and a one year detailed expenditure review. The structure of the bus service industry after the 1968 Transport Act and the 1972 Local Government Act is summarised in Table 1.3:

Table 1.3: Bus industry structure 1974 (a) (b)

1 Type of Operator	2 Passenger Journeys (mill.)	3 Passenger Receipts (£mill.) (c)	4 Vehicle Stock (000s)	5 Vehicle Kilometres (mill.)	6 Staff Employed (000s)
LTE (d)	1,472	74.6	6.9	280.5	32.3
PTE	2,228	129.7	11.1	510.6	44.4
Municipal	1,187	56.9	6.2	250.7	21.3
NBC	2,148	189.0	20.8	986.1	70.9
SBG	373	38.2	4.6	187.8	14.4
Private	273	20.6	27.8	143.9	32.1
Total	7,682	509.0	77.4	2,359.6	215.4

Source: Transport Statistics Great Britain 1964-1974, 1976, Department of Environment, HMSO: Tables 42, 43, 45, 44 and 49.
Notes:

(a) Data for columns 2, 3 and 5 are for stage (i.e. bus) services only. The data for vehicle stock and staff employed is for buses, coaches and (a negligible number of) trams.
(b) Data for 1974 is given because this is the earliest year for which data is available on all the operator types above, for stage services, and for columns 2, 3 and 5. This makes Table 1.4 directly comparable with Table 3.2.
(c) Passenger receipts include concessionary fare payments.
(d) London Transport Executive

The importance of the local authorities and the NBC in the provision of stage services outside London is evident. The private sector provided a very small proportion of stage services, since the bulk of its work is concentrated on the provision of excursions and tours, contract and private hire work. Since columns 2, 3 and 5 of Table 1.3 relate to the provision of stage services, but columns 4 and 6 relate to the provision of bus and coach services, care must be taken in the interpretation of any performance ratios derived from Table 1.3, especially in trying to compare private and public operator performance. In Table 1.4 below, for example, the very low figure for vehicle kilometres operated per vehicle for the private operator sector simply reflects the relatively small amount of *stage* vehicle kilometres operated by that sector, rather than any inefficiency in the utilisation of its capital stock. Nevertheless, Table 1.4 may be useful in making comparisons between public sector operators, for whom stage services form a much greater part of their total services.

There are other problems involved in determining appropriate efficiency and performance indicators for the bus service industry, particularly for cross-section comparisons between operators (Mackie and Nash, 1982). It is unclear whether the level of aggregation in Table 1.3 would reduce or increase these cross-section problems. A comparison of West Midlands PTE with the Bristol Omnibus Company, for example, may indicate significant differences in their operating conditions, such as peak vehicle requirements and passenger densities. A more aggregate comparison between the PTE and municipal sectors, on the other hand, may reduce these differences.

Performance indicators can be categorised into three types: cost efficiency, cost effectiveness and service effectiveness (Fielding *et al.*, 1978). Cost efficiency measures the relationship between service inputs (labour, capital and fuel) and service outputs

(vehicle miles, vehicle hours and capacity miles). Cost effectiveness measures the relationship between service inputs and service consumption (passengers, passenger miles and operating revenue). Service effectiveness measures the relationship between service outputs and service consumption. It is possible to identify certain performance indicators that are better than others at representing the underlying performance characteristics across different samples (Fielding *et al.*, 1985). The performance indicators in Table 1.4 are based on those recommended in this latter study, although data limitations mean that some of the preferred variables (e.g. revenue vehicle hours, peak vehicles, passenger miles and labour costs) cannot be included in Table 1.4.

Labour and vehicle efficiency are cost efficiency indicators: a rise in these ratios represents an increase in output (vehicle kms) from the given input (staff employed, vehicle stock). Service utilisation and revenue generation are indicators of service effectiveness. Service consumption is an indicator of cost effectiveness, although the preferred variable in the denominator is labour costs, rather than units of labour.

Table 1.4: Bus industry performance indicators 1974

1 Type of Operator	2 Labour efficiency	3 Vehicle efficiency	4 Service utilisation	5 Passenger revenue generation	6 Network revenue generation	7 Service consump-tion
LTE	8.7	40.6	5.3	5.1	26.6	45.6
PTEs	11.5	46.0	4.4	5.8	25.4	50.2
Municipal	11.7	40.4	4.7	4.8	22.7	55.7
NBC	13.9	47.4	2.2	8.7	19.2	30.3
SBG	13.0	40.8	2.0	10.2	20.3	26.0
Private	4.5	5.2	1.9	7.5	14.3	8.5
Total	10.9	30.5	3.3	6.6	21.6	35.7

Source: ratios derived from Table 1.3 as follows:
Notes:
Labour efficiency = vehicle kilometres (VK)/staff employed (SE) i.e. vehicle km (000s) per member of staff employed
Vehicle efficiency = VK/vehicle stock (VS)
Service utilisation = passenger journeys (PJ)/VK
Passenger revenue generation = [passenger receipts (PR)/PJ]*100 i.e. pence per passenger journey
Network revenue generation = [PR/VK]*100 i.e. pence per vehicle km
Service consumption = PJ/SE

The performance indicators highlight the difference in operating conditions between the NBC/SBG and the rest of the public sector operators. For the NBC/SBG, both service utilisation and consumption are relatively low because of the rural nature of many routes.

Low passenger densities imply fewer passengers for a given network (as measured by vehicle km) and labour force. The low service utilisation, in conjunction with high vehicle efficiency, indicates a high proportion of empty seats on NBC services. The NBC response to this mismatch between supply and demand was to redesign its service network through the Market Analysis Project of the late 1970s/early 1980s. Tables 1.3 and 1.4 are later used in conjunction with Tables 1.5 and 1.6 to assess the changes that occurred in the industry between 1974 and 1984.

As previously noted, direct comparison between public and private sector operators is invalid for the performance indicators shown. If labour efficiency is defined in terms of vehicle stock to staff employed (i.e. the capital-labour ratio), however, then a direct comparison is possible because both variables relate to the provision of stage (bus) *and* non-stage (coach) services. Using this indicator of labour efficiency, the private sector is four times more efficient than LTE, and nearly three times as efficient as the other public sector operators. Nevertheless the comparison may be misleading because of the relatively high proportion of non-stage services run by the private sector: differences in labour efficiency may then result from differences in operating conditions, rather than the use of labour *per se*.

1.6 The Transport Act 1978

This Act changed the licensing criteria of the 1930 Road Traffic Act by requiring the Traffic Commissioners to take into account the views of local authorities in the granting of a road service licence. Specifically:

"In exercising their discretion to grant, refuse or vary a road service licence in respect of any route and their discretion to attach conditions to any such licence, the traffic commissioners shall have regard to the interests of the public and in particular to:

(a) any transport policies or plans which have been made by the local authorities concerned and have been drawn to the Commissioner's attention by those authorities;

(b) the transport requirements of the area as a whole (including both the commissioners' own traffic area and, so far as is relevant, adjoining traffic areas) and of particular communities in the area;

(c) the need to provide and maintain efficient services to meet those requirements;

(d) the convenience of persons who are disabled."

(Transport Act, 1978, Schedule 2).

The criteria for attaching conditions to the licence were also changed. Item (b) relating to fares was amended to " where desirable in the public interest having regard to the nature of the service the fares shall be so fixed as to prevent wasteful competition", so that the Commissioners had to take account of the type of service as well as the public interest. There was another criterion added so that "in appropriate cases passengers are enabled to continue their journey by another means of transport".

The Act also re-affirmed the role of the shire county councils in the co-ordination of transport, and required them to prepare and publish an annual Public Transport Plan for the forthcoming five-year period. The Plan had to set out the transport needs of the county and the ways in which these needs were to be met. Proposals for concessionary fare schemes, for example, had to be included. The Act also introduced the licensing of vehicles as community buses using volunteer drivers who were not required to hold a PSV licence, and provisions to encourage car sharing.

1.7 The Transport Act 1980: purpose and provisions

In a speech soon after the passing of the Act, the Rt. Hon. Norman Fowler (then Secretary of State for Transport) explained that its purpose was:

a. the removal of bureaucratic restriction

b. the need to ensure that almost everyone gains good access to public transport

c. the provision of maximum choice to the user, by facilitating competition

(Quoted in Kilvington and Cross, 1986, p. 3).

The Act made very significant changes to both the coach and bus sectors. In particular, the road service license (RSL) requirement was abolished for express services and, although it was retained for stage services, the Act made it easier for operators to obtain. This section describes the main provisions of the Act. The next section discusses its effects.

The Act changed the definition of an express service from one on which there was no ordinary fare of less than 21 pence to one where every passenger must travel over 30 miles, measured as a straight line distance either from start to finish of the journey or from some intermediate point on the journey to its start or finish. A stage carriage service continued to be one on which passengers were carried at separate fares and which was not an express, excursion or tour service. This redefinition, operational from 6 October 1980, caused some services previously classified as express (those services where the fare was greater than or equal to 21 pence but the distance travelled was 30 miles or less) to be reclassified as stage carriage services from this date. This reclassification causes a comparability problem in the express and stage data before and after this date.

The Act also redefined a public service vehicle as a motor vehicle that is either

"a vehicle adapted to carry more than eight passengers, is used for hire or reward", or which "being a vehicle not so adapted, is used for carrying passengers for hire or reward at separate fares in the course of a business of carrying passengers."

(Transport Act, 1980, Part I, 2 (1)).

In order not to discourage car-sharing schemes involving payment for travel, vehicles used for this purpose are exempt from the second PSV criterion as long as

"the fare or aggregate of the fares paid ... does not exceed the amount of the running costs of the vehicle for the journey; and ... the arrangements for the payment of fares were made before the journey began"

(Transport Act, 1980, Part I, 2(4)).

The Act required operators running stage, express or contract hire services to have a Public Service Vehicle (PSV) Operator's Licence. This change meant that, with effect from April 1981, the old system of vehicle licensing was replaced by operator licensing. Operator Licences are granted by the Traffic Commissioners, and a separate licence is required for each Traffic Area in which the service operates. The standard licence authorises the operator to use any type of PSV, whereas a restricted licence allows the use only of a PSV designed or adapted to carry eight passengers or less. This limit is raised to sixteen passengers where the PSV is not used for a business involved in carrying passengers (local authority use, for example) or where the use of the PSV is by a person whose main occupation is not usually the operation of PSVs. The granting of such licences is governed by the 1977 Public Service Vehicles Operators (Qualifications) Regulations, which were enacted to harmonise UK and European legislation. Applicants must satisfy the Traffic Commissioners that they are of good repute, and have appropriate financial standing, professional competence and adequate maintenance facilities. They must also make "adequate arrangements for complying with the law relating to the driving and operating of the vehicles" (Transport Act, 1980, Part I, 18 (8)). Licences are

valid for up to 5 years, and stipulate the maximum number of vehicles that can be operated. All vehicles operating under the licence must display a disc to that effect.

The requirement for a Road Service Licence was abolished for express and excursion services. Although the requirement was retained for stage carriage services (excluding Education Authority and Community Bus services), the 1980 Act made it easier to obtain the licence in two ways. Firstly, it is no longer expected that operators provide evidence to the Traffic Commissioners on the need for and suitability of their proposed service, as was the case under the 1930 Road Traffic Act: the Traffic Commissioners must grant the licence unless they are satisfied "that to do so would be against the interests of the public" (Transport Act, 1980, Part I, 8 (1)). In their assessment of "public interest", the Commissioners are required to take account of:

(a) the transport requirements of the area as a whole (including so much as is relevant not only of the commissioner's own traffic area but also of adjoining traffic areas) and of particular communities in the area;

(b) any transport policies or plans which have been made by the local authorities;

(c) any objections or other representations made to the commissioners in the prescribed manner which in their opinion are relevant.

(Transport Act, 1980, Part I, 5 (3)).

These conditions no longer include those relating to need and suitability contained in the 1930 Road Traffic Act. Secondly, in the event of an objection by other operators, the onus of proof is transferred from the applicant to the objector(s): it is now the objector who must prove that the service is against the public interest.

In granting an RSL the Commissioners are explicitly prevented from attaching conditions relating to fares, unless the public interest is threatened by the abuse of

monopoly power (via overcharging) or uncontrolled competition (via undercutting). Specifically, fare conditions can only be attached

"to protect the public from unreasonable use by the holder of the licence of his position as such; or ... to regulate the terms of competition between stage carriage services on any route or routes."

(Transport Act, 1980, Part I, 7 (3)).

Finally, the 1980 Act allowed local authorities to designate "Trial Areas" in which RSLs are not required for stage carriage services, thereby allowing local authorities the discretion to introduce a deregulated system. This opportunity was taken up by Norfolk, Hereford and Worcester, and Devon. Operators in these areas are required to:

(a) "give to the local authority concerned, and to every district council in whose area passengers will be taken up or set down in the course of the service in question ... a notice giving the prescribed information about the new service, the changes or the discontinuances ...

(b) publish in a local newspaper, circulating in the locality served or to be served by the service a notice giving the prescribed information ..."

(Transport Act, 1980, Part I, 14 (2)).

In conclusion, the 1980 Transport Act deregulated the express service sector, strengthened quality licensing by the introduction of operator licensing, removed fare control in the stage as well as the express sector, made it easier for stage service operators to obtain an RSL, and gave local authorities the power to introduce deregulated stage services in Trial Areas. This legislation, together with other current public transport regulations, was consolidated into the Public Passenger Vehicles Act 1981. The effects of the 1980 Transport Act are discussed in Volume I, Section 2.5.1.

1.8 Bus Industry Structure, Trends and Performance 1974-84

Given the stream of legislation affecting the local bus service market from the late 1960s onwards, it is of some interest to examine the structure, trends and performance of the stage service bus industry between the 1968 and 1985 Transport Acts. Table 1.5 shows the structure of the industry by type of operator in 1984. It is directly comparable with Table 1.3, and enables the trends in the bus industry to be derived for the period 1974-84. These trends are shown in Table 1.6. It should be noted that the data for passenger journeys, passenger receipts and vehicle kilometres are for stage (i.e. bus) services. Unfortunately, it is not possible to obtain data on vehicle stock and staff employed for stage services only: the figures shown include data for buses, coaches and (a negligible number of) trams.

Table 1.5: Bus industry structure 1984 (a)

1 Type of Operator	2 Passenger Journeys (mill.)	3 Passenger Receipts (£mill.) (b)	4 Vehicle Stock (000s)	5 Vehicle Kilometres (mill.)	6 Staff Employed (000s)
LRT (c)	1,162	82.8	5.7	267	31.9
PTEs	1,811	121.0	9.5	475	37.6
Municipals	821	63.8	5.3	223	17.0
NBC	1,387	163.3	14.5	827	47.4
SBG	299	37.9	3.1	168	9.2
Private	171	21.8	30.8	164	38.4
Total	5,650	490.8	68.8	2,125	181.5

Source: Department of Transport Statistics Report, November 1991, HMSO: Tables 2.2, 5.2, 6.1, 1.3 and 7.1.

Notes:

(a) Data for columns 2, 3, and 5 are for stage services: data for columns 4 and 6 are for stage and non-stage services.

(b) Passenger receipts include concessionary fare payments and are adjusted for an increase in the consumer price index of 216.6% over the period 1974-84.

(c) London Regional Transport.

The PTEs and NBC still dominated the provision of stage services outside London, but against a background of continuing decline in the stage service industry. This decline

occurred mainly because the demand for car travel was still increasing. Table 1.6 shows the extent of the decline in the industry between 1974 and 1984:

Table 1.6: Bus industry trends 1974-84 (% changes)

1 Type of Operator	2 Passenger Journeys	3 Passenger Receipts (a)	4 Vehicle Stock	5 Vehicle Kilometres	6 Staff Employed
LRT	-21.1	+11.0	-17.4	-4.8	-1.2
PTEs	-18.7	-6.7	-14.4	-7.0	-15.4
Municipals	-30.9	+12.1	-14.5	-11.1	-20.2
NBC	-35.4	-13.6	-30.3	-16.1	-33.2
SBG	-19.8	-0.8	-32.6	-10.5	-36.1
Private	-37.4	+5.8	+10.8	+14.0	+19.6
Total	-26.5	-3.6	-11.1	-9.9	-15.7

Source: derived from Tables 1.3 and 1.5.
Note:
(a) Adjusted for inflation using the consumer price index 1974 = 100, 1984 = 316.6.

Passenger journeys declined significantly across the industry. The NBC suffered a particularly large fall in demand for its stage services and made corresponding adjustments to its labour and capital requirements by redesigning its service network (the Market Analysis Project). The PTEs did not suffer to the same extent because their low fares policies succeeded in retaining some demand which would otherwise have been lost. The number of staff employed fell not only because of the fall in passenger journeys but also because of the rapid introduction of one person operation (OPO) vehicles in the late 1960s and early to mid 1970s. The change to OPO was encouraged by the introduction of the New Bus Grant in 1968, although this was phased out in 1983. Passenger journeys fell faster than vehicle kilometres for all public sector operators, indicating an increase in unused capacity and thus a greater mismatch between supply and demand.

Although stage service passenger journeys declined sharply for the private sector, this type of service formed less than 10% of its total service provision. Contract and private hire passenger journeys formed nearly 70% of its total passenger journeys in 1982 (Buses

White Paper, *op. cit.*), and the relatively good performance of this sector of the market is the reason for the 10.8% increase in private sector vehicle stock.

The most surprising trend in Table 1.6 is the increase of 14% in *stage* service vehicle kilometres operated by the private sector. Even allowing for the relatively small base on which it is calculated, for deficiencies in the accuracy of data collected from private sector operators, and for the effects of the change in definition of express and stage services from 6 October 1980, the size of this increase, particularly in the context of the overall 37.4% decrease in stage service passenger journeys for the private sector, is remarkable. One reason may have been the growth of the coach market and a desire to make use of any spare capacity in this market by developing new services in the stage market. The development of new stage services was also made easier by the 1980 Transport Act. These arguments are purely conjectural, however. The Buses White Paper does not mention the increase, concentrating instead on the decline in the public operator sector.

Table 1.7 shows performance indicators derived from Table 1.6:

Table 1.7: Bus industry performance indicators 1984

1 Type of Operator	2 Labour efficiency	3 Vehicle efficiency	4 Service utilisation	5 Passenger revenue generation	6 Network revenue generation	7 Service consump-tion
LRT	8.4	46.8	4.4	7.1	31.0	36.4
PTE	12.6	50.0	3.8	6.7	25.5	48.2
Municipal	13.1	42.1	3.7	7.8	28.6	48.3
NBC	17.4	57.0	1.7	11.8	19.7	29.3
SBG	18.3	54.2	1.8	12.7	22.6	32.5
Private	4.3	5.3	1.0	12.8	13.3	4.5
Total	11.7	30.9	2.7	8.7	23.1	31.1

Source: ratios derived from Table 1.6 as follows:
Labour efficiency = vehicle kilometres (VK)/staff employed (SE) i.e. vehicle km (000s) per member of staff employed
Vehicle efficiency = VK/vehicle stock (VS)
Service utilisation = passenger journeys (PJ)/VK
Passenger revenue generation = [passenger receipts (PR)/PJ]*100 i.e. pence per passenger journey
Network revenue generation = [PR/VK]*100 i.e. pence per vehicle km.
Service consumption = PJ/SE

As with Table 1.4, care should be taken in making comparisons between private and public operators because of the much lower proportion of stage service vehicle kilometres run by private operators. For public operators, the NBC/SBG had the highest labour and vehicle efficiency indicators, but also the lowest service utilisation and consumption indicators. In order to compare relative performance over the period 1974 to 1984, Table 1.8 shows the percentage change in the performance indicators over the period:

Table 1.8: % Change in performance indicators 1974-84

1 Type of Operator	2 Labour efficiency	3 Vehicle efficiency	4 Service utilisation	5 Passenger revenue generation	6 Network revenue generation	7 Service consump-tion
LRT	-3.4	+15.3	-17.0	+39.2	+16.5	-20.2
PTE	+9.6	+8.7	-13.6	+15.5	+0.4	-4.0
Municipal	+12.0	+4.2	-21.3	+62.5	+25.6	-13.3
NBC	+25.2	+20.2	-22.7	+35.6	+2.6	-3.3
SBG	+40.8	+32.8	-10.0	+24.5	+11.3	+25.0
Private	-4.4	+1.9	-47.4	+70.7	-7.0	-47.1
Total	+7.3	+1.3	-18.2	+31.9	+6.9	-12.9

Source: derived from Tables 1.4 and 1.7.

For the public sector operators there was a general (but not universal) improvement in labour and vehicle efficiency, particularly for the NBC/SBG. The sharp decline in passenger journeys caused a worsening of the service utilisation and consumption indicators, with the exception of the SBG. In terms of revenue generation, all public sector operators improved their performance, although there was considerable variability in this improvement. Increases in receipts per passenger journey ranged from 15.5% for the PTE sector to 62.5% for the municipal sector. The low increase for the PTE sector reflects the tendency of Labour controlled metropolitan counties to implement low fares policies. The effect of this low fares policy is also evident in the revenue generation for the PTE network, although the NBC also experienced a small increase. Finally, although the private sector experienced a fall of 37.4% in its stage service passenger journeys over the period, it managed to increase its receipts per stage service passenger journey by 70.7%, a margin which is much greater than all but one of the public sector operators.

1.9 The Provisions of the 1985 Transport Act

In spite of the considerable diversity of opinion on the Buses White Paper proposals, they were embodied virtually unchanged into the 1985 Transport Act. The Act contained 140 sections and 8 schedules. The structure and scope of the Act is outlined in Table 1.9:

Table 1.9: Structure and scope of the 1985 Transport Act

Section/Schedule Numbers	Topic(s) Covered
1 - 9	Deregulation of local services
10 - 17	Taxis and hire cars
18 - 23	Minibuses and community buses
24 - 33	Public service vehicle operators' licences
34 - 46	Regulation of road passenger transport in London
47 - 56	National Bus Company
57 - 87	Functions of local authorities and PTEs
88 - 92	Subsidies and competitive tendering
93 -105	Travel concessions
106 - 112	Grants
113 - 140	Miscellaneous and general
1 - 3	Listing of and amendments to relevant Acts
4	Establishment of Transport Tribunal
5	Disabled Persons Transport Advisory Committee
6	Arrangements for transitional period
7 - 8	Amendments and repeals resulting from 1985 Act

Details of the 1985 Transport Act are contained in a number of sources[1]. The main provisions and implications of the Act are discussed within the following sub-sections.

1.9.1 Road Service Licensing

Road service licensing was abolished throughout Britain, except for London, from 26 October 1986 ("Deregulation Day" or "D-Day"). This opened up the bus industry to new operators and marked the end of the quantity controls inaugurated by the 1930 Road

[1] A useful reference for the detailed provisions of the 1985 Transport Act is "Your Guide to the 1985 Transport Act", Transport Publishing Projects, 1986.

Traffic Act. London was considered to be a special case, and the decision on whether to deregulate in the capital was deferred.

1.9.2 Local Services

The definition of types of service, which had changed on 6 October 1980, was changed again from 6 January 1986. Prior to 6 January 1986 a stage service was one on which passengers were carried at separate fares and which was not an express service, excursion or tour. From 6 January 1986 a *local* service is one on which passengers are carried on a public service vehicle at separate fares and can travel for less than 15 miles, measured as a straight-line distance[2]. In effect, stage services are reclassified as local services, and express services are redefined as those involving passenger journeys over 15 rather than 30 miles. Privately organised services and those run under a minibus permit by educational or other bodies are excluded from this definition. Services run under a community bus permit are included: these services are defined as local non-profit making services operated by a body concerned for the community's social and welfare needs. The effect of the definitional change is to reclassify services into either "local" or "other", where the latter category includes contract, private hire, express, excursions and tours not registered as local services.

1.9.3 Registration of Services

Operators wishing to run a local service outside Greater London from 26th October 1986 were required to register the details of the service with their Traffic Commissioner before 28th February 1986. Since local authority subsidy can only be obtained via the competitive tendering process from D-Day, the presumption is that registered services will be "commercial" services. Registration is only permitted by the holder of a PSV Operator's Licence ("O" Licence), the holder of a community bus permit, or a person

[2] The actual definition used in the 1985 Transport Act is somewhat more complex than this, in order to encompass cases such as circular journeys and extra distances caused by estuarial crossings etc.

using a school bus to carry fare paying passengers. The number of Traffic Commissioners for each Traffic Area is reduced to one.

During the initial or "settling-in" period from 26th October 1986 to 25th January 1987 operators could not register new services or reduce or withdraw from their existing registered services, except in "exceptional circumstances". From 26th January 1987, however, operators are allowed to cancel or vary a registered service, or register a new service, provided that a period of notice is given before the service change takes place: this will normally be 42 calendar days. Failure to provide registered services may cause the Traffic Commissioners to withdraw the operator's right to provide such services. In addition, the Traffic Commissioners also have the power (in consultation with the police and local authorities) to impose conditions on routes and stopping places in order to produce an outcome which is "orderly and fair to all operators involved" (Buses, White Paper, 1984, p.13).

1.9.4 Services, Subsidy and Competitive Tendering

The Act creates a distinction between those services provided without subsidy ("commercial" services) and those that will not be provided unless subsidy is paid by the local authority ("tendered" services). After 28 February 1986 non-registered services could be regarded as uncommercial and in need of subsidy from the local authority, assuming the authority wished to continue the service. In reaching this decision the local authority must consider whether or not the service is "appropriate": the Act does not use the terms "necessary" or "socially necessary". The provision of a subsidised service must not inhibit competition. Given the tighter financial constraints imposed on local authorities with respect to subsidy provision after 1983 it is inevitable that non-registered services will be closely scrutinised and prioritised by local authorities to determine whether they are appropriate and, if this is the case, the extent to which a subsidy for them will yield "value for money". Non-registered services fulfilling the local authority criteria for subsidy will be put out to tender by the local authority during the transitional period ending on 25 October 1986. Unless the services are tendered, they cannot usually

be subsidised by the local authority. Tenders can only be accepted from operators holding an "O" Licence or a community bus permit. In order to spread the administrative work associated with tendering, local authorities can issue contracts for varying lengths of time up to and including a five-year period.

The two main types of tender can be classified according to the incidence of risk. The first type is where the authority pays the amount required by the successful bidder for running the service but keeps the revenue collected (sometimes referred to as "full cost, minimum cost or fixed cost tenders). With this type of tender, the risk is borne by the authority. The second is where the successful bidder specifies the amount required and keeps the revenue collected (sometimes referred to as minimum subsidy, bottom line or net cost tenders). In this case, the risk is borne by the operator. Under the second method, there is an incentive for the operator to attract more passengers to the service because of the possibility of extra profit. The Price Waterhouse report (TRRL, 1990) suggests that companies generally preferred minimum subsidy to minimum cost tenders "because they felt confident of their ability to improve profitability on the route, once the tender had been won" (p.30). The extra risk, however, may deter smaller operators from tendering. Authorities are not obliged to put a service out to tender where the subsidy involved is relatively small (under £4000): this is known as a "de minimis" contract. The 1985 Act is not specific on a number of matters relating to the tendering process. These include whether a number of services can be put out to tender as a group if clear benefits can be demonstrated from this grouping, or the sanctions which can be applied to operators who do not fulfil the terms of the contract.

In awarding a contract for a subsidised service, local authorities can take into account not only the subsidy requirement itself, but also other costs and benefits associated with the service. They are also obliged to co-operate with each other in determining their expenditure on public passenger transport services. In general, local authorities must seek "to secure, in the interests of the ratepayers of their areas, the best value for money from their expenditure on public passenger transport, taken as a whole" (Section 88). If the overall total of subsidy required from this tendering process exceeds the budget available

(including the effect of cost-savings), the authority will have to consider cutting some uncommercial services. All operators are given the right to participate in concessionary fare schemes: previously, local authorities often restricted participation. Local authorities are given the power to compel operator participation in such schemes provided that compensation is given for any net financial loss incurred by the operator.

1.9.5 Privatisation and the National Bus Company (NBC)

The NBC was created by the 1968 Transport Act and operated via subsidiary companies throughout England and Wales. These companies included Midland Red, Yorkshire Traction, Ribble and the National Express network of inter-city coaches.
Section 47 of the 1985 Act required the NBC to prepare and implement a plan for the sale of the company, subject to the approval of the Transport Secretary. The aim of this plan was "to promote sustained and fair competition". In contrast to the provisions of the 1968 Transport Act, which had required operators to co-ordinate passenger transport services, the 1985 Act meant that privatised NBC companies had to compete not only with each other but also other operators such as the Passenger Transport Executives.

The Transport Secretary could only approve the disposal plan with the consent of the Treasury, so that the plan was expected to achieve a good sale price for each privatised component. This financial constraint could potentially have conflicted with the competitive requirement, since smaller companies might not have been as attractive to buyers. The disposal plan could, with the Transport Secretary's consent, allow for employee's share schemes to be established so that employees had the right to buy shares in their company: the scheme could also allow shares to be "transferred" to workers free of charge.

The first NBC subsidiary was sold in July 1986. By October 1987, 45 of the 72 operating subsidiaries had been sold of which 27 were the subject of management and/or employee buyouts. The last NBC subsidiary to be sold was in April 1988, when London Country Buses (North-east) was bought by Parkdale. Of the 72 subsidiaries, 38 were sold to their

managements and/or employees, and a further 7 sold to various of these 38; 24 were sold to private-sector companies, 2 were sold to combinations of management and other operators, and Victoria Coach Station was sold to London Regional Transport. Overall then, about two-thirds of the sales were management and/or employee buy-outs, with the remaining third sold to the private sector. Sale prices in the earlier stages of the privatisation process were considered to be relatively low because of the uncertainty about the industry's performance in a competitive environment. Many of these earlier sales were management buy-outs, but an increasing proportion of sales went to private companies. Subsequent resales saw the emergence of large companies with extensive bus operating interests: by January 1990 Stagecoach had acquired six ex-NBC companies, with Badgerline and Drawlane five each.

In July 1989 the Transport Act (Scotland) received Royal Assent, thereby making provision for the sale of the Scottish Bus Group (SBG). Its thirteen subsidiaries were restructured into eleven companies because of the merging of Strathclyde area subsidiaries Central Scottish and Kelvin Scottish, and Clydeside Scottish and Western Scottish. The sale of the SBG operating companies to the private sector began with the publication of the Disposal Programme in February 1990 and was completed in October 1991.

1.9.6 The Metropolitan Areas

The 1968 Transport Act introduced the concept of "Passenger Transport Areas", in which the Passenger Transport Authorities and Executives had a joint duty "to secure the provision of a properly integrated system of public passenger transport to meet the needs of the area with due regard to the town planning and traffic and parking policies of the district councils and to economy and safety operation". The 1972 Local Government Act created metropolitan counties, to which the boundaries of the Passenger Transport Areas were adjusted.

The 1985 Act limited the responsibilities of the PTA to formulating general policies concerned with the provision of bus (and rail) services where such services are not provided by the free market. The PTE is still required to implement the policies of the PTA. Neither body can any longer take into account the transport needs of its area, the degree of integration of services, or co-operation with the NBC. In particular, they have a duty not to inhibit competition between operators providing public transport services in their area.

Each PTE was also required to form an "initial company" (generally referred to as a "Passenger Transport Company") to which it would transfer its bus undertakings and other related activities, subject to the approval of the Transport Secretary. The Transport Secretary could then specify a date on which the shares in the initial company were to be transferred from the PTE to the PTA. In the event, this date was fixed for deregulation day. The effect of this transfer of ownership is that PTEs cease to be bus operators but are still responsible *inter alia* for the provision of tendered bus services, the administration of the competitive tendering process, the general marketing of public transport, the administration of concessionary fare schemes, and the subsidy of local rail services. Under section 85 of the Act, the Transport Secretary is empowered, with the consent of both Houses of Parliament, to transfer the PTEs functions and assets to the PTA and to dissolve the PTE. There is no time-scale for this power, and whether it is exercised may depend on the success of the PTEs in carrying out their remaining functions.

In addition, the PTA was obliged to submit proposals to the Transport Secretary for splitting up the initial company into two or more smaller companies limited by shares. These companies were known as "transferee companies", and were small enough to ensure that they could not inhibit competition. Although the 1985 Act did not specifically require the privatisation of these companies, their creation was designed to expedite this process should the Transport Secretary decide that it was necessary. During 1987 and 1988 the Transport Secretary, disappointed by the relative lack of competition in many of the metropolitan areas, announced that Government policy was in favour of privatising the PTCs.

Bus operations in the metropolitan areas were also affected by the abolition of the metropolitan county councils on 1 April 1986. From this date responsibility for the English PTEs was transferred to the PTAs, which consist of committees of councillors appointed by all the district councils within each metropolitan county.

1.9.7 The Non-metropolitan Areas

Under the 1972 Local Government Act the non-metropolitan county councils (i.e. the shire county councils in England and Wales, and the regional councils in Scotland) possessed wide co-ordination powers. Section 63 of the 1985 Transport Act imposes limitations on these powers similar to those on the metropolitan councils. They are required to formulate general policies to secure the provision of public transport services not provided by the market, and in such a way that competition in their area is not inhibited. In the process of policy formulation they are required to consult any PTA, county council, district council or bus operator that may be affected by the policy.

District councils operating bus undertakings, commonly referred to as municipal bus undertakings, were required to set up one or more companies to take over the operation of their bus undertakings. Each district council had then to draw up a plan for the transfer of the municipal bus undertaking to one or more companies, with the plan being subject to the approval of the Transport Secretary. On approval of the scheme, the transfer of ownership can take place. The companies created under this procedure should be small enough to ensure that competition is not inhibited.

The term "Public Transport Company (PTC)" thus refers to a company created in one of three ways: firstly, by a PTE forming an "initial company" (section 59 of the 1985 Act); secondly, by a PTA forming a "transferee company" (section 61); and thirdly, by a district council (section 67). The metropolitan PTCs became companies owned by their PTAs, and operate predominantly in the six English metropolitan areas and the Strathclyde Region. Their operations, formerly controlled directly by the PTEs, are now conducted at "arm's length" from the PTEs, which are now responsible to the PTAs for

the public transport functions discussed in the preceding section. The municipal PTCs became companies owned by their district councils in England and Wales, and regional councils in Scotland, and operate at "arm's length" from these councils. Several former PTCs are now in private sector ownership. The constitution and activities of the PTCs are defined in the 1985 Act, particularly their financial activities. If, for example, the PTC is in financial difficulties, the controlling authority can mount one rescue operation only. This could take the form of a loan or a guarantee from the PTA or district council, subject to the Transport Secretary's permission. Given the preceding comments, it is evident that the Transport Secretary was given considerable powers in the shaping of the post-deregulation bus industry.

1.9.8 Anti-competitive Practices

Prior to the 1985 Act most agreements between bus operators were exempt from the provisions of the Restrictive Trade Practices Act 1976. Under section 115 of the 1985 Act any "registrable" agreement between bus operators becomes subject to the provisions of the Restrictive Trade Practices Act 1976. A registrable agreement is one between two or more operators which restricts their ability to compete: the agreement could relate to service provision, fares, picking up and setting down conditions, area and scale of operation, and ticketing arrangements. The registration must be made with the Director General of Fair Trading within three months from the date of the agreement and before it is put into effect. The role of the Director General is to ensure fair competition. Once an agreement is registered, the Director General has the discretion to refer it to the Restrictive Practices Court. The Director General may decide, taking into account factors such as the size of the firms and the competitive environment in which they operate, that the agreement is not significant enough to warrant referral or, if it is significant, to persuade the operators to amend the agreement. If any agreement, significant or not, is not registered in time it becomes illegal, and adversely affected parties can sue the operators concerned.

The 1985 Act makes bus stations subject to the provisions of the Fair Trading Act 1973 and the Restrictive Practices Act 1976. Discriminatory practices such as refusing access to an operator, or charging different fees for use of the bus station, are now illegal.

1.9.9 Quality Control

Although quantity control is abolished in the bus and coach sectors, the Buses White Paper makes it clear that quality controls should be "fully retained and reinforced" (p. 6). The 1985 Act makes a number of modifications to the supervisory system, especially the operator licensing system, without radically changing its structure. The police and local authorities are allowed to object to the granting of a PSV Operator's Licence ("O" Licence), although the onus of proof lies with the objector. Objections can be made on the basis of the operator's repute, financial standing, professional competence and maintenance arrangements.

Traffic Commissioners are given the power to attach two conditions, additional to those contained in the Public Passenger Vehicles Act 1981, to an "O" Licence. These conditions prohibit an operator from providing any local service or a specific local service if:

(i) the operator has run an unregistered local service, or not run a registered service as specified in the registration process

(ii) the maintenance arrangements of the operator are unsatisfactory

(iii) the operator, or his employees or agent(s), are guilty of serious misconduct: this could include dangerous driving or interfering with the running of another operator's local service.

A public inquiry must be held when these conditions are attached. The Commissioners also have the power to revoke an "O" licence, either for a limited time period or

indefinitely. Appeals against the decisions of the Commissioners concerning "O" licences are made to the Transport Tribunal, established under schedule 4 of the 1985 Act, and not to the Transport Secretary as was originally the case. In cases where a restricted "O" Licence is granted, the maximum number of vehicles that can be operated is reduced to two.

Regulations relating to the inspection and prohibition of public service vehicles are extended to any motor vehicle (excepting trams) which are adapted to carry more than eight passengers. The "fair wages" clause for the employees of PSV operators in section 28 of the Public Passenger Vehicles Act 1981 is repealed.

1.9.10 Other Provisions

Some modifications are made to the licensing system in London, but essentially the 1985 Act retains the road service licensing system for London local services. Thus London local services are not deregulated by the Act. Changes are made to the system of taxi and hire car licensing in Britain which, *inter alia*, allow holders of a taxi or hire car licence to run a local service subject to the granting of a special restricted "O" Licence by the Traffic Commissioner. Two new types of rural bus grant are introduced: a total fund of £1.27 million to encourage innovative transport schemes for rural communities, and a transitional rural bus grant to maintain vital rural services in the period before the cost reductions from competitive tendering take effect. This latter grant lasts for four years, starting at £20 million and reducing by £5 million in succeeding years. Finally, the Disabled Persons' Transport Advisory Committee was set up to consider matters referred to it by the Transport Secretary, and to make an annual report to the Secretary.

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APPENDIX 2

Measures to Prevent Strategic Entry Deterrence

2.1 The "Half-headway" Rule

This section describes a simple guideline rule devised by the author to reduce entry barriers in the form of unnecessary service duplication. If such a rule is to be implemented, it should aim to limit incumbent response to entry whilst at the same time promoting the interest of the passenger. In general, models of horizontal product differentiation support the view that social welfare is maximised by a uniform spacing of bus departure times (see Volume I, Section 3.3.3.2). Thus the guideline should seek to encourage uniform spacing without placing unreasonable restrictions on an operator's freedom to introduce additional services. Service duplication usually involves scheduling services a few minutes earlier than a rival service ("frontrunning"), and it is this strategy which the guideline should seek to prevent. It is not inconceivable that "backrunning" may occur, but this would not in general seem a particularly profitable activity and can therefore be ignored.

A sensible solution would involve a "half-headway" rule, where headway measures the shortest length of time between the new service and its preceding and following ones. Suppose that operator A has buses running every twenty minutes from 8.00 hrs. Figure 2.1 below shows A's existing 8.00 and 8.20 services and some of the entry and response possibilities. The order of entry and response is shown by the figure in brackets. In Figure 2.1 (i) operator B introduces a service at 8.10, giving a headway (= H) of ten minutes. Operator A then has a right to schedule a service at a time not less than (0.5)H in front of B's 8.10, which in this case will be at 8.05. If this rule is not observed, operator A is guilty of predatory behaviour and the Traffic Commissioner can deregister the service.

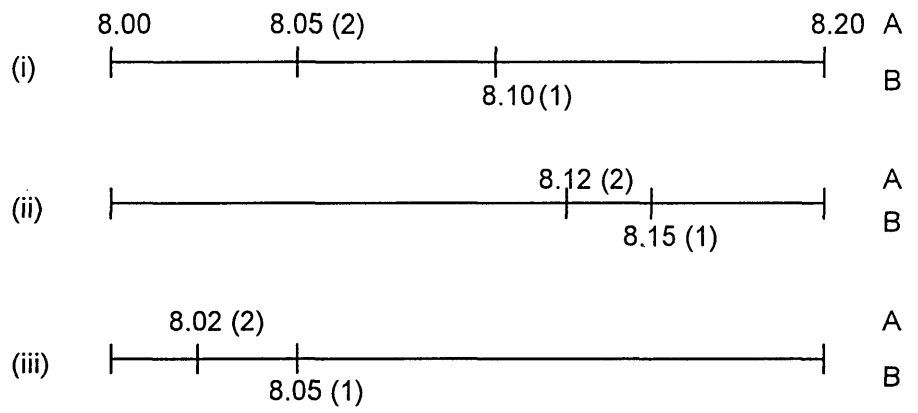

Figure 2.1: Entry and incumbent response for half-headway rule

In Figure 2.1 (ii) B introduces a service at 8.15 rather than 8.10, so that the headway time is now 5 minutes. Assuming that services are timetabled in integer minute values, A could then introduce a service at 8.12 (but not later). Alternatively, in Figure 2.1 (iii) B introduces a service at 8.05, so that headway time is still 5 minutes (i.e. the shortest headway time is now between the new service and the preceding one) and A could respond with a service at 8.02. It is hard to see why B would follow the 8.05 option, however, since there is the strong possibility that the preceding 8.00 service will have taken a significant proportion of B's potential patronage. If A does introduce services, then B has the option of responding within the "half-headway" rule and so on.

Suppose that more than one service is introduced by B. If these are timed at 8.10 and 8.15, then A could respond with services no later than 8.05 and 8.12, and so on. Since service times must be registered at least 42 days in advance with the Traffic Commissioners, the system should be relatively easy to police. The fact that 42 days notice of a service withdrawal must also be given will tend to inhibit excessive service registrations: having once registered a service, the operator must run it for at least six weeks. Naturally, if we disallow non-integer minute values, then a headway of one minute implies that further response is impossible. But such a very small headway is likely to produce problems of congestion at bus stops, and Traffic Commissioners already have powers under the 1985 Transport Act to impose conditions on routes and stopping

places to produce an "orderly and fair" outcome. Services that leave very small headway times are thus not likely to be a significant problem, since the Traffic Commissioners can change or deregister them.

The rule not only places a constraint on incumbent (and entrant) responses, but will also tend to produce a uniform spacing of services. If operator B is concerned about A's response, the safest strategy will be to enter halfway between A's services, since this will produce the maximum time interval between B's service and A's possible response. This is 5 minutes in Figure 2.1 (i) compared with 3 minutes in (ii) and (iii). The rule is easy to understand and monitor, and would enable Traffic Commissioners to prevent service registrations in the "gray areas" over which they currently have no control. It may be argued that the rule is difficult to enforce where the route in question is an overlap of two competing services following generally different routes. In this case, it may be impossible for the rule to be observed on the overlap section of the routes if there are constraints on operators on the other parts of the routes.

In cases such as this it is left to the discretion of the Traffic Commissioners to decide whether intervention is feasible. It should be noted, however, that the rule would enable Traffic Commissioners to end the more blatant cases of service duplication. Such examples are not too difficult to find:

"...perhaps he could explain why, when the service was introduced, Thamesway chose a route identical (save for minor variations) to Southend Transport's well established X1 and why his off-peak service still leaves Southend five minutes ahead of the hourly X1. True innovation would have seen Thamesway look at different routes to London ... or running on the opposite half hour to the incumbent operator."

(Letters, Coach and Bus Week, 14.10.95)

2.2 The Predatory Pricing Guideline

This section contains details of a guideline devised by the author to reduce the incidence of predatory pricing. Such a guideline could be based on standard economic theory which suggests that, for a service to be provided at all, it must at least cover its short run variable costs. A predatory price would then be defined as one that failed to cover these costs. Since the predatory pricing guideline (PPG) should be easily understood and easily quantified, labour and fuel costs would be appropriate measures of these costs. Given the journey time, mileage and patronage for the service, the formula to determine a predatory price for a service between any points A and B would be:

$$P < \frac{L+F}{N}$$

where P = fare per non-concessionary passenger
L = labour costs i.e. driver (plus conductor, if applicable) costs
F = fuel costs
N= number of passengers (concessionary and non-concessionary)

This formula is generous to operators wishing to reduce price, since it excludes other variable costs such as maintenance. By definition it also excludes fixed costs. It also excludes price reductions where the operator is still able to make a profit. There could be no serious objection from operators that the formula was somehow "unfair" to them. On the other hand it is not too generous, since labour costs alone typically form about 75% of total variable costs (and about 50-60% of total costs). The formula would apply to both incumbents and entrants, and would extend to any service offered at the alleged predatory price. This latter condition would preclude an operator initially charging a predatory price (as defined above) and then waiting for passenger numbers to increase until the price was no longer predatory. Any instance of predatory pricing would be grounds for intervention by the OFT.

Concessionary fares for children and old age pensioners would be not be included in the formula, provided that they are part of an arrangement with the local authority by which

operators are reimbursed for concessionary travel. The pricing rule should not interfere with the provision of such schemes. In general, local authorities reimburse operators for concesssionary fare schemes in such a way that the operator receives an amount per concessionary passenger roughly equivalent to the fare per non-concessionary passenger (subject to an adjustment for generated patronage). From the operators' viewpoint, therefore, the revenue per concessionary passenger will be similar to the revenue per non-concessionary passenger. Because of this, the fare per non-concessionary passenger is an appropriate measure of revenue per passenger whether or not a concessionary scheme is in operation. Since concessionary passengers carry equal weighting with non-concessionary passengers in terms of average revenue per passenger, it follows that they should be included along with non-concessionary passengers in the measurement of N and thus in the measurement of variable costs per passenger.

One line of defence would be open to the operator, who could argue that the alleged predatory price arises because the service forms a return journey for which patronage is so low that it is impossible to set a fare that will cover average variable costs. A typical situation would be one of joint supply where the outward journey (e.g. suburbs to city centre in the morning peak) is profitable, but the return journey (e.g. city centre to suburbs in the morning or evening off-peaks) is unprofitable. In this case, the operator would be allowed to nominate one outward service only, where the outward service must travel between the same points as the return service, and use this outward service as a justification for providing a loss-making return service. In this case the pricing formula (using subscripts 1 and 2 to refer to the return and outward services respectively) would be amended to:

$$\frac{(P_1.N_1 + P_2.N_2)}{N} < \frac{(L_1 + F_1 + L_2 + F_2)}{N}$$

where N= N1 + N2. Essentially, if the combined revenue from the return and outward services is lower than their combined costs, then the fare charged for the return service is predatory.

It could be argued that the pricing rule takes no account of the network effects discussed in Volume I, Section 4.5.4: a service may be unprofitable (or satisfy the above formula) when considered on a stand-alone basis, but may have significant revenue or cost interdependencies with other services that enable it to be provided as part of a service network which is profitable overall.

But these network effects depend significantly on economies of scope and density, which arise through the spreading of fixed costs over larger (or different) units of output. These fixed costs do not affect the firm's short run production decision, and so the pricing rule is appropriate on the assumption that the incident is of a short run nature i.e. there are no significant changes in the size of factors such as depot facilities. This seems a reasonable assumption, given the usually short duration of predatory pricing incidents. In addition, if network effects are unlikely to be highly significant in the USA airline industry (see Volume I, Section 4.5.4), then it also seems unlikely that they would be highly significant in the UK bus industry, where the capital to labour ratio is lower.

The severity of the punishment should depend on the size of the firm. A fine could be imposed on the firm, where the amount of the fine is some fixed proportion (say 1%) of the firm's turnover. This proportion could itself vary with the number of predatory pricing offences committed by the firm: the more offences, the higher the proportion becomes for each subsequent offence.

To conclude, the PPG conforms to economic theory, in that firms must cover their short run variable costs in order to justify producing anything. It allows a certain margin of error on the operator's part, however, by not including all variable costs. The disadvantage of this is that it would not remove predatory pricing completely, since an operator could set a price that covered labour and fuel costs but not total variable costs. But the implementation of such a rule would undoubtedly reduce the number of actual cases of predatory pricing, and also the ability of operators to threaten such pricing. There would, for instance, be no question of operators introducing, or threatening to introduce, zero or other obviously loss-making fares. The OFT would not need to consider the

feasibility of price predation, or the motives and intentions of the alleged offender. An alternative is to require incumbent operators to continue their fare cuts (or service increases) for a fixed length of time (Williamson, 1977, Baumol, 1979) where entry has occurred. The danger with this policy is that, in the absence of a specific rule to determine whether a fare cut is predatory, *any* fare cut in response to entry could be liable to this penalty. An incumbent operator might legitimately argue that increased supply must necessarily force price down: the real issue that has to be addressed is not the price reduction *per se*, but whether it covers the variable costs of providing the service.

2.3 The Role of the OFT and the MMC

The transition from regulation to competition in the UK bus industry has not meant that all forms of regulation have disappeared. There is still a significant element of "residual" regulation. Operators are still required to observe safety regulations. They are still normally required to give 42 days notice to the Traffic Commissioners of new services or changes to existing ones. Traffic Commissioners can withdraw an operator's right to provide services if the terms of the registration are not adhered to, and can also impose conditions on routes and stopping places. The bus industry is subject to the provisions of the 1973 Fair Trading Act, the 1976 Restrictive Practices Act and the 1980 Competition Act.

In particular, under section 115 of the 1985 Transport Act any agreement between bus operators which is capable of restricting competition becomes subject to the provisions of the 1976 Restrictive Trade Practices Act. The agreement must be registered with the Office of Fair Trading (OFT), which then decides whether to refer it to the Restrictive Trade Practices Court. The decision is based not only on the anti-competitive aspects of the agreement, but also on any possible advantages the agreement may have in terms of the public interest. Price fixing and market sharing agreements are considered anti-competitive with no public interest advantages. Multi-operator travelcard schemes are not anti-competitive, provided there is no agreement on market sharing or non-travelcard prices. Other agreements, such as those on bus liveries, are technically anti-competitive

but unlikely to have any "perceptible effect" on competition. In these cases the agreement would be unlikely to be referred (OFT, 1991).

Of the first 239 bus agreements submitted to the OFT, 115 were found to be objectionable, but only two were subsequently referred to the Court (Beesley, 1990). This low rate of referral may reflect a number of factors: firstly, the OFT's informal advice to operators on how to modify unacceptable agreements; secondly, a reluctance to intervene in the market in a proactive way; thirdly, a desire to proceed with caution in an industry undergoing a rapid amount of change; and finally, a lack of resources to deal effectively with the number of agreements. Much of the OFT's time is spent on investigations into other areas such as credit licensing. The OFT also has a problem with suspected unregistered agreements between operators, since the Restrictive Trade Practices Act confers only limited powers of investigation into them (Borrie, 1987).

In addition to Competition Act references to the Monopolies and Mergers Commission (MMC), the OFT also has the power to refer certain mergers and monopolies to the MMC under the Fair Trading Act. This is particularly relevant for the UK bus industry, where there has been a significant degree of merger in the post-deregulation period. One criterion for referral is where the merger results in a market share of 25% or more of the supply or purchase of goods in the UK or a "substantial" part of it. The interpretation of this criterion is difficult in the case of the bus industry, where mergers often occur at a local level. Guidance was given in the report of the MMC on the BadgerLine merger in the county of Avon, which concluded that this was a substantial part of the UK. This area has a population of around one million people, and subsequent investigations appear to have been based on this figure (Mackie and Preston, 1993, p. 436). Given the scope of this definition, which would encompass many proposed mergers between large bus companies, it is clear that the MMC is particularly concerned to discourage mergers between geographically contiguous companies (Beesley, 1992. p.219).

The focus of MMC policy towards merger activity has been blurred, however, by contradictory policy from the Secretary of State for Trade and Industry (SSTI). The SSTI

overruled the MMC's recommendations in three out of the six bus company mergers investigated prior to 1991. In addition, an appeal by South Yorkshire Transport against the MMC was upheld by the Court of Appeal on the grounds that the reference area was *not* a substantial part of the UK. Although the MMC investigated six bus company mergers over this period, it declined to investigate any cases of local monopoly. This is rather surprising, given the existence of a number of local monopolies in areas including the West Midlands, Greater Manchester and Merseyside (Mackie and Preston, 1993, p. 437). On the other hand, the reluctance to investigate local monopolies may reflect a lack of resources or a view that potential competition is sufficient to prevent the abuse of monopoly power in these areas.

Criticisms of, and suggestions for changes in, the regulatory role of the OFT and MMC have been made by Mackie and Preston (*op. cit.*) and, more recently, by Carsberg (1995)[3]. The main criticisms relate to the lack of clear guidelines over what constitutes predatory behaviour and the lack of interim powers to enable the OFT to stop alleged anti-competitive behaviour whilst the investigation is in progress. The main recommendation is that the powers of the OFT should be strengthened in order to enable it to investigate complaints more swiftly and effectively. Alternatively, these and existing powers could be transferred to a new regulatory body (OFBUS) which would deal exclusively with anti-competitive practices in the bus industry. Another alternative is to broaden the powers of the Traffic Commissioners, who have specialist knowledge of local operating conditions (Association of County Councils *et al.*, 1994).

Although predatory behaviour is a problem in the UK bus service industry, it is important to keep this problem in perspective. Some instances of so-called "predatory behaviour", whether by small or large firms, may be reinterpreted as a legitimate part of the competitive process, depending on one's inclination (or lack of it) towards the benefits of competition. This attitude is clearly apparent in the views of the Austrian school, discussed in Volume I, Section 4.2. There is also the point that predatory behaviour, if it

[3] Sir Bryan Carsberg, Director General of Fair Trading, in evidence to the House of Commons Transport Committee, 1995, First Report, The Consequences of Bus Deregulation.

is profitable, is likely to be dominated by a more profitable alternative, namely merger. Mergers are relatively quick and avoid long and possibly risky competitive battles (McGee, 1958, pp.139-40). They may also increase cost efficiency and thus service provision via network effects. This is not to suggest that every merger is a surrogate form of predation: rather, it is to emphasise that the likelihood of predation is less than is sometimes supposed.

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APPENDIX 3

Exhaust Emission Valuation: methodological details

3.1 Derivation of Table 7.1 (Volume I) Results

The results in Table 7.1 (Volume I) are based on the figures given in the National Atmospheric Emissions Inventory 1997 (NAEI97) Report by Salway *et al.*, the UK Atomic Energy Authority 1994 (UKAEA94) Report by Gover *et al.*, various issues of Transport Statistics Great Britain (TSGB) and Bus and Coach Statistics Great Britain (BCSGB), and revised figures kindly supplied to the author by Tim Murrells of AEA Technology and Chris Megainey of the Department of the Environment, Transport and the Regions (DETR). The emission factors are not the legislated limit values for the Pre-stage I, Stage I and Stage II regulations, but representative limit values for the actual emissions which are likely to occur under these regulations. Thus the Stage II emission factor for petrol cars is based on a sample of petrol cars conforming to the Stage II regulations. In some cases, the emission performance of some vehicles may be better than that required by the legal limit.

Car emission factors in Table 7.1 include both "hot" and "cold" engine running, where cold running figures are based on the NAEI97 data which are for grammes per cold start *trip*. Although some of the hot emission figures are revised, no revisions are made to the cold start figures, and no cold start data appears in the revised figures. To derive a grammes per kilometre figure, it is necessary to use assumptions concerning trip length and vehicle distribution to obtain an overall (i.e. hot and cold) emission factor. This is achieved by using 1992 data on vehicle distributions and distances travelled to calculate Pre-stage I emission factors, and 1995 data to calculate Stage I emission factors, both based on the NAEI97 data. Stage II emission factors are then derived by scaling down the Stage I results using the Stage I and Stage II data from the revised figures. In this way an overall emission factor is obtained which incorporates the recent data revisions.

From 1971 to 1992 there have been several European Commission directives controlling road transport exhaust emissions for new vehicles, culminating in the introduction of Stage I (EC 91/441/EEC) which made three-way catalysts (TWCs) compulsory for new petrol engine cars from January 1993 (although "type approval" limits i.e. limits relating to new models of car, were operative from 1.7.1992). Prior to this, new petrol engine cars had to comply with Directive 83/351/EEC (equivalent to the UN/ECE R15.04 standard) introduced in 1983. The emission factors for the Pre-stage I petrol car category in Table 7.1 are based primarily on the emissions standards set by this 1983 directive, although an allowance is made for the (small) proportion of petrol cars fitted with TWCs in 1992. Data for Pre-stage I diesel cars is taken directly from the Pre-stage I data given in NAEI97 and the revised figures.

Data for buses does not include cold starts. Cold start data is not available for buses, and in any event cold start mileage is likely to form a relatively small proportion of total bus mileage. Data in NAEI97 and revised data are for large buses only, so are scaled down for mini- and midi-buses using the data given in TSGB (1995, Table 2.9) and Gover *et al.* (Table B12) for CO, HCs (used as a proxy for VOCs), NO_X and PM (used as a proxy for PM_{10}). Emissions for CO_2 and SO_2 are fuel related and scaled down using the fuel consumption figures in Gover *et al.* (Table B12).

From 1988 to 1992 new buses were subject to the Pre-stage I regulations, so that the bus vehicle stock in 1992 consists of these buses and those registered before 1988 ("old" buses). The Pre-stage 1 emission factor for large buses is based on a weighted average (determined according to vehicle life expectancy) of old (i.e. pre-1988) and Pre-stage 1 (i.e. 1988-1992 inclusive) large buses. Assuming a large bus has a life expectancy of 18 years, then in 1992 Pre-stage I bus emission factors are given a weight of 5/18 and old bus emission factors are given a weight of 13/18 in determining the overall emission factor for the Pre-stage I large bus figures given in Table 7.1.

3.2 Vehicle Distributions and Emission Factors for 1992, 1995 and 1999

The emission factors in Table 7.1 are for three sets of emission regulations. In order to determine the exhaust emission changes as a result of substituting bus for car travel in a given year, it is necessary to estimate the typical emission factors associated with the vehicle distribution (in terms of type and age of vehicle) in that year. For 1992 all buses and cars (apart from the small proportion of petrol cars fitted with TWCs) are assumed to conform to Pre-stage I emission factors. Details of these calculations are contained above. The situation in 1995 is less straightforward since some vehicles conform to Pre-stage I regulations, and some to Stage I. In 1999 the vehicle distribution contains a mixture of Pre-stage I, Stage I and Stage II vehicles. Values for 1999 for number of cars, number of buses, distance travelled etc. are estimated using the forecasts in the National Road Traffic Forecasts (NRTF) (1997).

Data on vehicle distributions for cars is not directly available, since vehicle kilometre data is not split between petrol and diesel cars or for age of car. NAEI97 circumvents this problem by using information from the Driver and Vehicle Licensing Agency (DVLA) to estimate vehicle survival rates and thereby vehicle distributions for cars by age and type (NAEI97, section 2.8.2.1.2). This DVLA information was not available to the author. Some DVLA data on buses is available in BCSGB, although the vehicle type classifications (by seating capacity) are different to those used elsewhere in BCSGB and in this analysis.

The vehicle distributions and the associated typical emission factors for 1995 and 1999 are therefore proxied by using estimates of average vehicle life expectancy. Petrol and diesel cars are assumed to have an average life expectancy of eleven years, based on Gover *et al.* (p. 7). Estimates of bus life expectancies were made after discussions with officials from DETR and the Society of Motor Manufacturers and Traders (SMMT). Information was also considered from the Transport and Road Research Laboratory (TRRL) Report (1990) on the financial viability of bus operators since local bus service

deregulation. The figures chosen are: minibus – eight years; midibus – ten years; large bus – eighteen years.

The CO emission factor for diesel cars in 1999, for example, is calculated in the following way. Given an eleven year life expectancy, the Stage II emission factor is given a weight of 4/11 (i.e. for the years 1996 to 1999 inclusive), the Stage I emission factor is given a weight of 3/11 (i.e. for the years 1993 to 1995 inclusive) and the Pre-stage I emission factor is given the remaining weight of 4/11. Using the data in Table 7.1, this gives a CO emission factor for diesel cars in 1999 of 0.5327 grammes per kilometre (i.e. (0.7807*4/11) + (0.4717*3/11) + (0.3305*4/11)).

Although the validity of this procedure cannot be checked for cars, it does gain support from the vehicle age distribution data given for buses in BCSGB. The proportion of small buses (approximately equivalent to mini- and midibuses) less than four years old in 1995 is 30 per cent of all buses, which is exactly the same as the weighting for midibuses of 3/10 derived from the above procedure, and not too dissimilar from the figure of 3/8 for midibuses.

This procedure is repeated for all vehicles and exhaust emissions for the years 1995 and 1999. These values are then used to calculate the net change in actual exhaust emissions (the actual emissions case) in Table 7.2. The procedure for the emission limit case in Table 7.2 is more straightforward, since all vehicles in 1992, 1995 and 1999 are assumed to conform to the Pre-stage I, Stage I and Stage II emission factors respectively.

3.3 Calculation of Changes in Vehicle Kilometres

The following calculations are for 1992, but the same procedures apply to 1995 and 1999. The average occupancy rate of cars is assumed to be 1.6 persons (National Travel Survey 1994/96), although the effects of varying this figure are discussed in the sensitivity analysis. A realistic expectation of peak load factors for both large and small buses is around 45 per cent (Glaister, 1985, p.69). The off-peak load factor is assumed equal to

the peak load factor on the grounds that, for marginal increases in bus passengers, the extra capacity in the off-peak can be used to increase load factors up to those in the peak. The sensitivity analysis discusses the effects of assuming different load factors. White (1995) gives typical capacities for a number of bus vehicle types. These capacities are 88, 50, 35 and 16 people for a double decker, single decker, midibus and minibus respectively. Assuming an average load factor of 45 per cent, the average number of passengers carried will be 39.6, 22.5, 15.75 and 7.2 respectively. The emission figures given in TSGB 1995 do not distinguish between double and single decker buses in the over 36 seat category. In order to estimate the average number of passengers carried for this latter category (hereafter referred to as the "large bus" category), the double and single decker (over 36 seat) average load factors are weighted by the respective proportions of each vehicle type in relation to the total stock of over 36 seat vehicles.

For 1992 these proportions are (20.9/50.3) and (29.4/50.3) respectively (BCSGB, 1993, Table 7.1). The resulting figure for average number of passengers carried by large buses is (39.6*(20.9/50.3)) + (22.5*(29.4/50.3)) = 29.6. The figures in Table 7.1 of BCSGB (1993) are for bus and coach vehicle stock, and include local and non-local work. The weights used above may not correspond exactly to those for local double and single decker bus stock, but are unlikely to be significantly different. In any event, it is not possible to disentangle local bus from non-local coach vehicle stock on the basis of the figures published in BCSGB. The figures in Table 7.1 (*op. cit.*) are also for the financial year 1992/93 rather than the calendar year 1992.

TWCs became compulsory for all new cars from January 1993, although they were available from 1988 onwards. The percentage of newly registered cars fitted with catalytic converters in any given year for the years 1988 to 1992 inclusive was 0.02, 0.42, 5.39, 17.38, and 46.00 respectively[4]. Information is not available for non-newly registered cars fitted with TWCs, but it is assumed that this figure is negligible. These figures imply that 3.5 per cent of cars currently licensed in 1992 were fitted with TWCs. Diesel cars represented about 4.5 per cent of total cars currently licensed in 1992 (TSGB,

[4] Information from the Society of Motor Manufacturers and Traders (London) 1.3.96.

1993, Table 5.3.4). Thus, for every 100 cars in 1992 on average, 92 were not fitted with a TWC, 3.5 were fitted with a TWC, and 4.5 were diesel engined.

On the assumption that the actual bus vehicle stock numbers in 1992 are optimally adjusted to reflect the preferences of existing bus users and former car users in that year, then the 160 former car users will transfer in the ratio 69:19:12 (BCSGB, 1993, Table 7.3) which measures the relative proportions of large bus, midibus and minibus stocks to the total bus stock. This assumption implies that there are transfers of 110.4, 30.4 and 19.2 people to large, midi- and minibuses respectively. Given the existing average number of passengers for each type of bus (29.6, 15.75 and 7.2 respectively), there will need to be an increase of 3.73 large buses, 1.93 midibuses and 2.67 minibuses in order to maintain this existing average, where 3.73 = 110.4/29.6 etc. These calculations are made on the basis of an average bus load factor of 45 per cent. It is of course possible that bus load factors will increase as a result of car to bus transfer, and this possibility is explored in the sensitivity analysis of Volume I, Section 7.5.

It is assumed that the average number of vehicle kilometres travelled by car in 1992 in Britain is equal to the total vehicle kilometres travelled by cars in 1992 divided by the total car stock in 1992. This gives a figure of 16,905.9 vehicle kilometres (TSGB, 1995). Assuming that 46.6 per cent of distance travelled by car is in urban areas (Gover *et al.*, 1994, Table B.6), then the average urban distance travelled by car is 7,878.15 vehicle kilometres.

BCSGB does not include data for the average distance travelled by type of bus, so it is assumed that each bus type has the same average distance travelled. The data for vehicle stock in BCSGB is for both buses and coaches (where coaches are used mainly for express or other non-local work), so it is not possible to measure directly the average distance travelled for local bus services. According to the National Travel Survey 1994/96 (DETR 1997, p. 22) buses and coaches cover about four times the average distance per year for cars, which implies a figure of around 31,500 urban vehicle kilometres for local bus services. This figure is likely to be an overestimate, however,

since it is based partly on coach services which tend to have a higher average distance travelled than local bus services. Given that coach services can form up to 35 per cent of total distance travelled by bus and coach, the overestimation could be fairly large. There is also the consideration that, where substitution of bus for car travel is an incremental process within an existing network of services, scheduling efficiencies may be available which reduce the marginal distance travelled below the average distance. For these reasons, the above figure is scaled down by a (conservative) factor of 20 per cent for use in the actual and emission limit cases.

Using these estimates, and assuming that petrol and diesel cars travel the same average distance each year, the changes in vehicle kilometres arising from a reduction in 100 cars for 1992 are:

Reduction in car kilometres travelled:

92 petrol cars (no TWC) * 7,878.15 km	= 724,789.8 petrol car (no TWC) km
3.5 petrol cars (with TWC)* 7,878.15 km	= 27,573.5 petrol car (with TWC) km
4.5 diesel cars * 7,878.15 km	= 35,451.7 diesel car km

Increase in bus kilometres travelled:

3.73 large buses * 24,698 km	= 92,123.5 large bus km
1.93 midibuses * 24,698 km	= 47,667.1 midibus km
2.67 minibuses * 24,698 km	= 65,943.7 minibus km

These changes in vehicle kilometres can then be used, in conjunction with the relevant monetary cost valuations, to calculate the changes in the costs of exhaust emissions, congestion, fuel consumption, noise, accidents and road damage. The net change in urban exhaust emission costs is shown in the penultimate column of Table 7.5, and the net changes in all the costs for different bus load factors are shown in Table 7.6.

In 1992 the total vehicle kilometres travelled by car (and taxis) in Britain was 338 billion (Transport Statistics Great Britain (TSGB), 1995, Table 9.4). These vehicle kilometres are allocated to each car category in proportion to the ratio 92.0:3.5:4.5. This procedure gives figures (in millions) of 310,960 kilometres, 11,830 kilometres and 15,210 kilometres respectively. These national totals are then converted to urban kilometres by multiplying by a factor of 46.6 per cent (Gover *et al.*, Table B7) to give urban totals of 144,907 kilometres, 5,512 kilometres and 7,088 kilometres respectively.

Total local bus service kilometres travelled in Britain in the financial year 1992/93 were 2,515 million (Bus and Coach Statistics Great Britain (BCSGB), 1993). This figure is used for the calendar year 1992. Total vehicle kilometres are allocated to the minibus category on the basis of the ratio of the number of minibuses to the total bus vehicle stock, and similarly for the midibus and large bus (over 36 seat) categories. This procedure gives national figures (in millions) of 301 kilometres, 468 kilometres and 1,745 kilometres respectively. Converting to urban totals by multiplying by a factor of 76 per cent (Gover *et al.*, Table B8) gives urban kilometres (in millions) of 140 kilometres, 218 kilometres and 813 kilometres respectively. Given these urban totals for car and bus travel, the total costs of urban exhaust emissions are calculated and shown in the final column of Table 7.5.

3.4 A Note on Data Revisions

The model cited in Volume I, Chapter seven (footnote 11) used national emission factor data based on Gover *et al.* (1994), apart from SO_X data which was estimated separately by the author. Gover *et al.* also gives urban emission factors. The revised urban figures for CO, VOCs, NO_X and PM_{10} used in Chapter seven are given in NAEI97, and further revisions (also including SO_2 and CO_2) were made available to the author. The revisions apply mainly to the data for petrol cars: the emission factors for buses for CO, VOCs, NO_X and PM_{10} do not contain any significant data revisions, although this is not the case for the SO_2 and CO_2 emission factors.

Some data revisions are favourable to bus travel. The revised figures contain PM_{10} emissions for petrol cars, where Gover *et al.* value them at zero. The revised figures for SO_2 (SO_X) are significantly lower than those estimated by the author, particularly for diesel engines. The revised emission factors for CO_2 are higher for petrol cars without three-way catalysts (TWCs) and diesel cars, but lower for buses. On the other hand, the revised NO_X emission factors are significantly lower for petrol cars without a TWC, and the revised CO factors are significantly lower for petrol cars with a TWC. This tends to favour car travel (although CO emissions are given a fairly low monetary cost valuation). Overall, however, the data revisions appear to favour bus travel in terms of the net change in exhaust emission costs.

3.5 An Example of the CarBus Model Spreadsheet

1995 actual vehicle distributions
Monetary values inflation adjusted to 1995 prices
SK*0.5 unit cost exhaust emission estimates

Parameter Values

a1=	-1	b1=	0.45	t1=	118505.7
a2=	0.72	b2=	25270	t2=	31272.3
a3=	0.19	b3=	0.116	t3=	14813.2
a4=	0.09	b4=	0.218	t4=	231.244
a5=	8026.88	b5=	0.666	t5=	434.579
a6=	1.6	b6=	16	t6=	1327.658
a7=	0	b7=	35	f1=	0.1081
a8=	0.83	b8=	64.782	f2=	0.0989
a9=	3.03	b9=	88	f3=	0.0636
a10=	31.22	b10=	0.389	f4=	0.1157
a11=	28.98	b11=	50	f5=	0.1938
a12=	0.0354	b12=	0.611	f6=	0.456
				p1=	0.601
				p2=	0.512
				p3=	0.514
				u1=	0.63

Effects of Reducing Car Use by 100 Cars:

Exhaust emission and fuel consumption cost changes

	PCNC	PCWC	DC	MNBUS	MDBUS	LABUS
NV	-0.72	-0.19	-0.09	0.03	0.02	0.04
AKT	8026.88	8026.88	8026.88	25270	25270	25270
GPKCO1	13.5991	3.1341	0.6963	0.8446	1.8026	13.4983
GPKVOC	2.32	0.30	0.16	0.24	0.64	4.16
GPKNOX	1.79	0.38	0.67	2.13	6.12	14.78
GPKSO2	0.03	0.03	0.11	0.15	0.25	0.59
GPKPM	0.04	0.01	0.17	0.27	1.36	1.25
GPKCO2	174.2	188.5	193.6	263.3	441	1037.7
TKGCO1	-7859.4	-478.0	-50.3	55.0	100.9	1246.8
TKGVOC	-1339.4	-45.1	-11.4	15.4	35.9	384.3
TKGNOX	-1033.6	-58.2	-48.4	138.7	342.3	1365.0
TKGSO2	-16.76	-4.73	-8.02	9.82	14.13	54.87
TKGPM	-20.81	-1.53	-12.01	17.60	75.94	115.75
TKGCO2	-100676	-28748	-13986	17151	24680	95853
CPTCO1	0	0	0	0	0	0
CPTVOC	0.89	0.89	0.89	0.89	0.89	0.89
CPTNOX	3.26	3.26	3.26	3.26	3.26	3.26
CPTSO2	33.61	33.61	33.61	33.61	33.61	33.61
CPTPM	31.20	31.20	31.20	31.20	31.20	31.20
CPTCO2	0.04	0.04	0.04	0.04	0.04	0.04
TCCO1	0	0	0	0	0	0
TCVOC	-1.20	-0.04	-0.01	0.01	0.03	0.34
TCNOX	-3.37	-0.19	-0.16	0.45	1.12	4.45
TCSO2	-0.56	-0.16	-0.27	0.33	0.47	1.84
TCPM	-0.65	-0.05	-0.37	0.55	2.37	3.61
TCCO2	-3.84	-1.10	-0.53	0.65	0.94	3.65
TC	-9.62	-1.53	-1.35	2.00	4.93	13.90
FUSAV	-34.04	-7.72	-2.36	3.87	5.57	21.65

Summary of Effects of Reducing Car Use by 100 Cars:
Exhaust emission and fuel consumption cost changes:

All car exhaust emission costs (£000)=	-12.49	All car fuel costs (£000) =	-44.13
All bus exhaust emission costs (£000)=	20.84	All bus fuel costs (£000) =	31.10
Total exhaust emission costs (£000)=	8.34	Total fuel costs (£000) =	-13.03

Total change in exhaust emission and fuel costs (£000) = -4.69

Total Annual Bus and Car Exhaust Emission Costs:

TKT	118505.7	31272.3	14813.2	231.2	434.6	1327.7
TTC	1971962	314184	275796	7246	38307	199839

Annual total car exhaust emission costs (£bn) = 2.562

Annual total bus exhaust emission costs (£bn) = 0.245

Annual total bus and car exhaust emission costs (£bn) = 2.807

Summary of Effects of Reducing Car Use by 100 Cars:
congestion costs

pcu1=	1	pcukm1=	18.4
pcu2=	1	pcukm2=	18.4
pcu3=	1	pcukm3=	18.4
pcu4=	1.2	pcukm4=	18.4
pcu5=	1.4	pcukm5=	18.4
pcu6=	1.64	pcukm6=	18.4

CONCO	-106.34	-28.06	-13.29	14.38	14.42	27.87

All car congestion costs (£000)= -147.69
All bus congestion costs (£000)= 56.67
Total change in car and bus congestion costs (£000)= -91.02

Summary of Effects of Reducing Car Use by 100 Cars:
noise costs

nckm1=	5.71
nckm2=	5.71
nckm3=	5.71
nckm4=	6.89
nckm5=	9.15
nckm6=	11.30

NOICO	-3.30	-0.87	-0.41	0.45	0.51	1.04

All car noise costs (£000s)=	-4.58
All bus noise costs (£000s)=	2.00
Total change in car and bus noise costs (£000s)=	-2.57

Summary of Effects of Reducing Car Use by 100 Cars:
casualty costs

cas1=	13.39
cas2=	13.39
cas3=	13.39
cas4=	29.39
cas5=	29.39
cas6=	29.39

CASCO	-7.74	-2.04	-0.97	1.91	1.64	2.71

All car casualty costs (£000s)=	-10.75
All bus casualty costs (£000s)=	6.27
Total change in car and bus casualty costs (£000s)=	-4.48

Summary of Effects of Reducing Car Use by 100 Cars:
road track costs

rtkm1=	0.0097
rtkm2=	0.0097
rtkm3=	0.0097
rtkm4=	0.0161
rtkm5=	0.0226
rtkm6=	0.0861

RTCO	-5.60	-1.48	-0.70	1.05	1.27	7.95

All car road track costs (£000s)=	-7.78	
All bus road track costs (£000s)=	10.27	
Total change in car and bus road track costs (£000s)=		2.50

Summary of Overall Changes in Costs (£000s) from Reducing Car Use by 100 Cars:

Load Factor	0.45
Air Pollution	8.341
Fuel Savings	-13.030
Congestion	-91.022
Noise	-2.575
Casualty	-4.476
Road Track	2.495
Total	-100.266

Key to parameter and variable terms used in spreadsheet:

a1 = reduction in cars (00s)
a2 = proportion of petrol cars (no catalyst) to total cars
a3 = proportion of petrol cars (with catalyst) to total cars
a4 = proportion of diesel cars to total cars
a5 = average annual kilometres travelled by car
a6 = average car occupancy (number of people per car)
a7 = cost per ton of CO_1 (£000s)
a8 = cost per ton of HC "
a9 = cost per ton of NO_X "
a10 = cost per ton of SO_X "
a11 = cost per ton of PM "
a12 = cost per ton of CO_2 "
b1 = average bus load factor (percentage)
b2 = annual average kilometres travelled by bus
b3 = proportion of minibuses to total buses
b4 = proportion of midibuses to total buses
b5 = proportion of large buses to total buses
b6 = capacity of minibus (number of people)
b7 = capacity of midibus (")
b8 = capacity of large bus (") [= (b9*b10)+(b11*b12)]
b9 = capacity of double decker (")
b10 = proportion of double deckers to total large buses
b11 = capacity of large single decker (number of people)
b12 = proportion of large single deckers to total large buses
t1 = total annual kilometres travelled by petrol car (no catalyst) (millions)
t2 = " " " " " " " (with catalyst) "
t3 = " " " " " diesel car "
t4 = " " " " " minibus "
t5 = " " " " " midibus "
t6 = " " " " " large bus "
f1 = average fuel consumption of a petrol car (no catalyst) (litres per kilometre)
f2 = " " " " petrol car (with catalyst) "
f3 = " " " " diesel car "
f4 = " " " " minibus "
f5 = " " " " midibus "
f6 = " " " " large bus "
p1 = price of 4 star leaded petrol (exc. duty and VAT) (£ per litre)
p2 = price of unleaded petrol " "
p3 = price of diesel (DERV) " "
u1 = proportion of motorists (exc. diesel cars) normally buying unleaded petrol
pcu1 = measure of relative congestion caused by PCNC
pcu2 = " " " " " " PCWC
pcu3 = " " " " " " DC

pcu4 = " " " " " " MNBUS
pcu5 = " " " " " " MDBUS
pcu6 = " " " " " " LABUS
pcukm1=congestion cost of PCNC (pence per km)
pcukm2= " " PCWC "
pcukm3= " " DC "
pcukm4= " " MNBUS "
pcukm5= " " MDBUS "
pcukm6= " " LABUS "
nckm1= noise cost of PCNC (£ per 1000 km)
nckm2= " " PCWC "
nckm3= " " DC "
nckm4= " " MNBUS "
nckm5= " " MDBUS "
nckm6= " " LABUS "
cas1= casualty cost of PCNC (£ per 1000 km)
cas2= " " PCWC "
cas3= " " DC "
cas4= " " MNBUS "
cas5= " " MDBUS "
cas6= " " LABUS "
rtkm1= road track cost of PCNC (£ per km)
rtkm2= " " " PCWC "
rtkm3= " " " DC "
rtkm4= " " " MNBUS "
rtkm5= " " " MDBUS "
rtkm6= " " " LABUS "

PCNC = petrol car no catalyst
PCWC = petrol car with catalyst
DC = diesel car
MNBUS = minibus
MDBUS = midibus
LABUS = large bus
NV = change in number of vehicles (00s) in each vehicle category
NV for minibus = [(a1*a6*b3)/(b6*b1)]
NV for midibus = [(a1*a6*b4)/(b7*b1)]
NV for large bus = [(a1*a6*b5)/(b8*b1)]
AKT = average kilometres travelled in each vehicle category
CO_1 = carbon monoxide
HC = hydrocarbons
NO_X = nitrogen oxides
SO_X = sulphur oxides
PM = particulate matter
CO_2 = carbon dioxide
GPK = emissions per kilometre (grammes) for each air pollutant in each vehicle

category
CPT = cost per ton of emissions (£000s) for each air pollutant in each vehicle category
TC = total cost of emissions (£000s) for each air pollutant in each vehicle category
FUSAV = fuel savings (£000s) (negative value indicates reduction in fuel costs) in each vehicle category
TKT = total annual kilometres travelled (millions) in each vehicle category
TTC = total annual air pollution costs (£bn) in each vehicle category
CONCO = congestion costs (£000s) in each vehicle category
NOICO = noise costs (£000s) in each vehicle category
CASCO = casualty costs (£000s) in each vehicle category
RTCO = road track costs (£000s) in each vehicle category

References for Appendix 3

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APPENDIX 4

The Data Set

4.1 Variable Sources

The data is obtained from a variety of sources[5]. UK data is from the Annual Abstract of Statistics (AAS), Population trends (PT), Economic Trends (ET), Economic Trends Annual Supplement (ETAS) and the UK National Accounts (UKNA). Transport data for Britain is from Passenger Transport in Great Britain (PTGB), Transport Statistics Great Britain (TSGB), the Department of Transport (DOT), the Department of the Environment, Transport and the Regions (DETR) and Bus and Coach Statistics Great Britain (BCSGB). Data from this last publication is provided in Focus on Public Transport (FPT) for 1997 onwards. London data is obtained from a number of the above sources, and also from the Abstract of Regional Statistics (ARS), Regional Statistics (RS) and Regional Trends (RT). Data for Northern Ireland income pre-1981 is from the Northern Ireland Digest of Statistics (NIDS) and the Northern Ireland Annual Abstract of Statistics (NIAAS).

4.2 Variable Descriptions

4.2.1 Passenger Journeys

Description: the total number of local bus service passenger journeys in Britain excluding London, where a passenger journey is a trip made by a passenger on a local bus service vehicle on one route (return tickets or round trips are counted as two journeys).
Source: PTGB (various) for 1953-73, TSGB (various) for 1974-84, BCSGB (various) for 1985-97.

[5] The author would particularly like to thank Mick Clary and Paul O'Hara (Department of the Environment, Transport and the Regions) for their help in providing extra data for local bus service travel.

Comments: A definitional change on 6th October 1980 means that some services previously classified as express (or long-distance) became stage (or local). Official data from 1975 onwards is revised to take account of this change, but not data before this date. Comparing years for which revised and unrevised data overlap, it is clear that any differences are small or negligible. The comparisons are made across four distinct sectors (London Transport, Local Authorities, Nationalised and Other). The largest difference is only 5 per cent, and this occurs in the smallest (Other) sector that consists of the private sector operators. Thus it would seem reasonable to ignore the effects of the definitional change, and this view is confirmed by the results of a chi-squared test, which finds that the only significant difference occurs in the Other sector. Given the small size of this sector, the revised and unrevised aggregate values should be very close to each other.

As a further check, more sophisticated tests were undertaken on this variable. These consist of determining the appropriate autoregressive, integrated, moving average (ARIMA) model for the variable and then including an intervention or dummy variable to test for the statistical significance of the change in definition. The results of this "intervention" analysis are inconclusive, mainly because of the difficulty in attributing the shift in the series at 1975 to the definitional change alone. In view of this, the results of the chi-squared test are relied on. It should also be noted that another definitional change occurred on 6th January 1986, when stage carriage services (i.e. those covering a distance of thirty miles or less) were replaced by local services (those covering less than fifteen miles). This change does not affect the passenger journey data significantly (TSGB 1977-87, p. 60) and thus no tests are conducted to determine its effect.

Prior to 1962 PTGB data does not identify local (or, more precisely, stage carriage) service passenger journeys by operator, although it does identify the split between different service types (stage carriage, express, excursions and tours, contract) at the aggregate level. The data for 1962 onwards shows that the proportion of non-stage to total bus passenger journeys is close to zero for London Transport, and it seems reasonable to assume that this was the case for the 1950s. The data for local service passenger journeys in Britain excluding London for 1953-1961 is thus derived by

subtracting the London Transport bus passenger journey data from the British local service passenger journey data. The figure for London for 1958 is distorted by the effect of the strike by London Transport employees. Since the passenger journey values (apart from that in the strike year) for London decline in an almost linear trend in the 1950s, the strike adjusted value for 1958 is estimated as the mean of the 1957 and 1959 values. This procedure is used in preference to retaining the actual value and allowing for the strike by a dummy variable (i.e. 1958 = 1, zero otherwise) in the model estimation, since this would use up valuable degrees of freedom in the regression analysis.

4.2.2 Vehicle Kilometres

Description: the total number of vehicle kilometres travelled by local bus services in Britain excluding London.
Source: PTGB (various) for 1953-73, TSGB (various) for 1974-84, BCSGB (various) for 1985-97.
Comments: this variable is subject to almost exactly the same comments as those for passenger journeys, and is adjusted in similar ways. The definitional changes in 1980 and 1986 are tested in the same way i.e. by chi-squared and time series intervention analysis, and are found not to have a significant effect on vehicle kilometres for Britain excluding London (although there was a significant effect in the relatively small Other sector).

4.2.3 Public Transport Support

Description: this term covers all forms of local authority current expenditure on public transport, excluding concessionary fares reimbursement. Data is for public transport support (PTS) to local bus services and includes payment to operators for the provision of subsidised services, payment for professional and technical services associated with the tendering process and publicity, and other expenditure such as the index-linking of pensions for some employees. Before deregulation, PTS was known as "revenue support".
Source: TSGB 1969-79 for 1969. Bus Data 1998 for 1970-96. FPT 1999 for 1997.

Comments: revenue support (later PTS) began in 1969. Before 1977 data is available for PTS in Britain, but not for London. The author made enquiries with the DETR, the Association of District Councils (London) and the Local Government Association (London) to trace the London data, but it could not be found. The figures for PTS in Britain excluding London for 1969-76 are estimated in the following way. For the ten years 1977-86 PTS for Britain is on average 50 per cent higher than the corresponding figure for Britain excluding London, with a small margin of fluctuation. This ratio is used in conjunction with the 1969-76 data on PTS for Britain to obtain estimates of PTS for Britain excluding London over this period. The change in definition from revenue support (RS) to public transport support causes a break in the data. The effect of the change is apparent in the figures for Britain for 1977-79, where revenue support is 16 per cent higher than PTS in all three years. The estimated RS data for 1969-76 is adjusted upwards by this percentage and spliced into the data for 1977-97.

4.2.4 Concessionary Fares

Description: this term covers the concessionary fare schemes started in 1969 and operated by local and regional authorities for groups such as elderly and disabled people and (since October 26th 1986) children. Operators are reimbursed for their participation in the schemes, after allowing for income generated from new passengers. Strictly speaking, the payments are subsidy to the passenger rather than the operator. The schemes are distinct from the fare reductions offered by many operators on commercial grounds.
Source: as for PTS.
Comments: before 1977 no data is available for concessionary fares for Britain excluding London. Estimates are made for the period 1969-76 with the same procedure used for PTS.

4.2.5 Population

Description: the total resident population of Britain, excluding London.

Source: AAS 1979 for 1953-60, AAS 1995 for 1961-93, PT Autumn 1995 for 1994. PT 1999 for 1995-97.

4.2.6 Personal Disposable Income

Description: the amount of money available to individuals in Britain (excluding London) after deducting income tax, national insurance contributions and net transfers abroad.
Source: ET (Jan.) 1999 for 1995-97. ETAS 1994 for UK 1950-90, ET (Oct.) 1995 for UK 1991-94, NIDS (various) for NI 1953-70, NIAAS (No.1) for NI 1971-80, ET November 1984 for NI 1981, ET May 1994 for NI 1982-92. Figure for NI 1993 supplied by Central Statistics Branch, Dept. of Environment, NI. Figures for NI 1994-97 estimated on basis of advice from Central Statistics Branch. London data from ET (various) for 1972 onwards, and from ARS (various) before this date.
Comments: before 1971 figures for NI personal disposable income are not given directly. NI personal disposable is derived as personal income (e.g. Table 109, NIDS, No. 36, Sep. 1971) minus the sum of income tax (measured by residuary share of reserved revenue) and national insurance contributions (e.g. Table 112, *op. cit.*). London data is for Greater London. Before 1972 figures are given for London total net income after tax, which is not quite the same as the London personal disposable income data given from 1972 onwards. Comparing the data overlap years of 1972 and 1973, the personal disposable income data is 25 per cent greater than the total net income after tax data. The data before 1972 is thus adjusted upwards by 25 per cent to make it comparable with the data from 1972 onwards. This seems a reasonable procedure, given that there are no major changes in the standard rates of tax over this period. There are missing observations for 1954-1958 inclusive, which are estimated by a simple linear trend interpolation.

4.2.7 Motoring Cost Index

Description: an aggregate index for purchase and running costs of UK private motor vehicles, based on consumer expenditure on motoring.

Source: consistent data for 1956-94 kindly provided by DOT 12.12.95. Data for 1953-55 estimated by author (see below). TSGB 1999 for 1995-97.
Comments: data is based on Central Statistical Office monthly price indices for the motoring expenditure component of the Retail Prices Index. This data is from a number of sources, including information provided by motor trade organisations. Data for 1953-73 includes motoring and cycling costs, from 1974-97 motoring costs only. This difference is assumed to have a negligible effect on the series. Data for 1953-55 is derived by comparing current consumer expenditure on motoring (and cycling) with that at constant prices and calculating the implied price index (data source: National Income and Expenditure, 1964). The aggregate price index takes account of a wide range of influences including purchase tax (where relevant), delivery charges, dealers' margins, petrol and oil, maintenance and repairs, garage rents, motor vehicle insurance, road tax and driving licences, driving lessons, driving tests and product quality changes. Detailed accounts of the methodology are provided in various supplementary texts to the national income accounts (e.g. UK National Accounts: Sources and Methods, 1985, HMSO, p. 73).

4.2.8 Bus Fares Index

Description: this variable measures the change in the average level of fares paid for local (or stage) bus services in Britain.
Source: PTGB 1962 for 1953-57, PTGB 1968 for 1958-67, TSGB 1988 for 1968-87, TSGB 1995 for 1988-93, FPT 1999 for 1994-97.
Comments: the data is derived from a sample of operators who account for approximately 90% of receipts from passengers on local services. Before 1977, passenger receipt figures include concessionary payments to operators. From 1977, concessionary payments are not included, so that the fare index measures the change in average fare paid directly by passengers. Thus the bus fare index before 1977 is not strictly comparable with that from 1977 onwards. In order to test whether this definitional change created a significant break in the data series used in the estimation model, a combination of augmented Dickey-Fuller (with structural break dummy) and Perron tests were used for the *real* bus fare

index in both ordinary and logarithm form. Both the ADF (with dummy) and Perron tests show that the definitional change did not have a significant effect on the integration properties of either of these series. Having established that the integration properties of the series are not affected, the series is modelled in ordinary form by the Box-Jenkins methodology i.e. as an ARIMA process. Using an AR(4), MA(11) process (selected using the Aikake Information Criterion) with a structural break dummy, it is found that the dummy is not significant. Thus it is concluded that the definitional change does not create a significant break in the real bus fares index.

4.2.9 Consumer Price Index

Description: the index of UK retail prices.
Source: ETAS 1995 for 1953-93. ET (Oct.) 1995 for 1994. ET (March) 1999 for 1995-97.
Comment: this variable is used to convert from nominal to real values for personal disposable income, motoring costs, bus fares, bus operating costs and subsidies. The retail price index is assumed to provide a better measure of prices facing the bus user than the GDP deflator. A consistent index of retail prices for Britain is not readily available for the period 1953-94.

4.2.10 Operating Costs

Description: local bus service operating costs for Britain excluding London, pence per vehicle kilometre.
Source: BCSGB for 1985-97, author's estimates for 1953-84.
Comments: before 1985 primary data on local bus service operating costs is not available. A series for 1953-97 is constructed by using data on numbers employed in the bus and coach industry, average weekly earnings of bus and coach drivers, diesel prices and local service vehicle kilometres. Operating costs (i.e. labour and fuel costs) per vehicle kilometre can then be estimated, and the estimated figures for 1985-97 compared with the

actual figures for 1985-97. The method appears to work well, with a reasonably small average annual error of 3.9 per cent between the actual and estimated figures.

Data for 1953-58 (AAS, various) give a breakdown of employment in the bus and coach travel sectors. Subsequent data does not give this information. Coach travel accounts for about 9 per cent of total employment, a fairly stable proportion over the period, so this figure is used to exclude coach travel employment from the bus and coach data. Bus and coach average earnings data from 1970-97 is from BCSGB (various) and FPT (1999). Before 1970 average earnings data for the Transport and Communications sector from the Monthly Digest of Statistics (MDS) is used as a proxy for bus sector average earnings. The figures from 1970 onwards are closely related to those given in BCSGB (1997), allowing the MDS figures to be spliced into the BCSGB figures at 1970.

Diesel prices from 1963 onwards are from various issues of PTGB and TSGB. They exclude Fuel Duty (since this is rebated in full or in part to bus operators). Before 1963 no price data is given for DERV, so the data for medium fuel oil from AAS (various) is used as a proxy. An advantage of using this fuel category is that the data is net of duty, whereas the motor spirit data includes it. Total fuel costs are based on an average fuel consumption of 4.24 kilometres per litre.

Depreciation cost data could not be obtained for the period prior to 1985, so the operating cost data does not include depreciation and thus does not incorporate the effects of changes in vehicle replacement rates and new investment in vehicles. As long as depreciation costs form a reasonably stable proportion of total costs over time, however, the slope coefficients in the estimated models will not be affected. Comparing BCSGB data for 1985-97 for operating costs including and excluding depreciation, this seems a reasonable assumption to make.

4.2.11 Bus Fleet Structure

Description: the ratio of double decker buses to total buses.

Source: PTGB (various), TSGB (various), BCSGB (various), London data 1990-97 from DETR.

Comments: this variable proxies the change in fleet structure as a result of deregulation. Vehicle stock data is for buses and coaches, since official data does not distinguish between buses used for local services and coaches used for long-distance services. As long as the number of buses relative to coaches stays reasonably stable over time, the inclusion of coaches in the bus fleet structure variable should not cause a significant problem. Where data for the structure of the London bus fleet is not available (1965-83), estimates of double deckers are made on the basis of passenger seating capacity data.

4.3 The Data Set: variables and observations

4.3.1 Key to Variables

GB = Great Britain
NLT = Great Britain excluding London
LT = London

D = demand for bus travel (passenger journeys per person)
Y = personal disposable income per person (real)
Pb = bus fare index (1953 = 100, real)
Pc = motoring cost index (1953 = 100, real)
V = service frequency (vehicle kilometres per person)
F = bus fleet structure (ratio of double-deckers to total bus fleet, 1953=100)
OC = bus operating costs (pence per vehicle kilometre, real)
SUB = public transport support plus concessionary fare revenue (pence per vehicle kilometre, real)

4.3.2 *Observations*

Date	FLT	FNLT	FGB	DLT	DNLT	DGB
1953	100	100	100	438.302	295.4	319.616
1954	101.316	102.058	101.886	420.123	295.696	316.659
1955	101.26	103.766	103.067	410.615	294.411	313.852
1956	99.775	106.752	105.192	389.359	286.846	303.875
1957	99.775	109.433	107.493	377.772	269.189	287.096
1958	98.515	111.159	108.614	357.212	261.469	277.134
1959	96.833	112.715	109.558	335.77	254.983	268.102
1960	96.833	113.205	109.924	315.834	249.895	260.52
1961	94.5	115.212	111.255	309.372	241.857	252.569
1962	94.239	116.068	111.972	303.657	231.755	243.093
1963	95.667	116.165	112.207	297.064	224.52	235.883
1964	95.667	116.161	112.213	274.997	216.125	225.3
1965	97.195	114.986	111.379	268.134	201.669	211.66
1966	96.013	113.79	110.115	252.361	189.466	198.736
1967	93.768	111.313	107.664	253.453	178.371	189.33
1968	89.796	107.809	104.132	250.605	167.785	179.756
1969	84.825	104.797	100.934	231.832	161.66	171.68
1970	81.572	99.685	96.123	197.281	153.647	159.786
1971	78.131	95.736	92.239	198.737	141.32	149.176
1972	74.646	92.063	88.679	192.085	136.852	144.296
1973	72.087	87.533	84.448	197.881	134.965	143.327
1974	72.197	85.624	82.822	204.871	130.671	140.416
1975	71.41	83.332	80.752	202.535	127.917	137.71
1976	68.259	82.507	79.679	200.592	120.308	130.714
1977	73.077	81.507	79.5	195.807	115.224	125.56
1978	72.277	79.904	78.008	187.275	111.596	121.215
1979	71.003	78.359	76.5	179.007	109.552	118.296
1980	73.442	81.585	79.766	172.384	105.181	113.583
1981	71.481	79.749	77.734	158.537	96.13	103.879
1982	73.171	80.804	78.989	153.858	93.244	100.73
1983	72.01	79.845	77.709	160.942	93.594	101.889
1984	85.191	80.652	80.23	171.995	93.112	102.81
1985	93.382	78.96	79.388	170.213	92.827	102.327
1986	88.2	75.899	75.9	171.808	86.106	96.608
1987	85.837	72.531	72.474	178.287	83.943	95.465
1988	81.457	70.591	70.376	179.807	81.974	93.829
1989	81.435	67.435	67.511	175.844	79.275	90.973
1990	79.235	66.592	66.575	173.388	74.668	86.65
1991	80.742	64.207	64.323	168.896	71.168	82.997
1992	74.731	61.963	61.987	163.505	67.72	79.45
1993	64.667	58.744	57.94	161.114	65.853	77.53
1994	62.431	57.039	56.41	167.48	65.341	77.881
1995	68.499	55.889	55.827	171.971	63.624	76.953
1996	64.809	52.539	52.839	175.573	62.081	76.131
1997	59.348	48.112	48.387	181.691	60.603	75.644

Date	VLT	VNLT	VGB	YLT	YNLT	YGB
1953	82.196	65.825	68.599	291.042	229.312	239.773
1954	79.493	65.951	68.233	304.532	235.394	247.042
1955	76.083	65.59	67.345	309.164	244.495	255.314
1956	75.683	65.457	67.156	313.518	250.673	261.112
1957	74.493	62.58	64.545	316.623	251.393	262.151
1958	70.548	62.021	63.416	322.77	253.174	264.562
1959	66.454	61.449	62.262	338.639	267.839	279.336
1960	63.498	60.72	61.167	359.172	281.817	294.281
1961	64.542	59.74	60.502	373.414	290.684	303.81
1962	64.344	58.939	59.792	381.43	287.477	302.292
1963	61.62	58.393	58.898	396.961	295.985	311.801
1964	61.121	57.545	58.103	406.291	308.062	323.371
1965	60.32	55.432	56.167	415.321	313.012	328.391
1966	58.52	54.094	54.746	425.444	318.519	334.278
1967	59.165	52.253	53.262	441.238	319.817	337.541
1968	57.612	50.637	51.645	476.943	318.833	341.688
1969	54.309	49.128	49.867	390.382	337.011	344.631
1970	42.275	48.278	47.434	417.715	344.174	354.52
1971	42.809	47.538	46.891	413.18	344.507	353.903
1972	41.576	45.607	45.064	448.41	367.762	378.631
1973	40.065	44.684	44.07	472.925	388.07	399.347
1974	39.04	43.748	43.13	485.719	386.44	399.478
1975	39.56	45.515	44.733	477.818	388.504	400.225
1976	41.191	44.913	44.431	464.502	385.443	395.691
1977	41.072	43.122	42.859	453.863	373.075	383.437
1978	39.873	42.425	42.1	488.213	406.136	416.568
1979	38.328	41.278	40.907	527.272	428.154	440.633
1980	40.724	41.38	41.298	535.832	426.439	440.116
1981	41.287	38.764	39.078	518.777	421.646	433.706
1982	39.166	38.447	38.536	532.774	418.059	432.228
1983	39.088	38.54	38.607	554.377	428.785	444.254
1984	39.668	38.527	38.667	551.311	446.349	459.253
1985	40.337	37.304	37.677	570.466	455.986	470.041
1986	41.033	38.796	39.07	586.64	479.238	492.4
1987	40.768	42.454	42.248	614.282	494.062	508.744
1988	42.316	43.096	43.001	647.105	523.247	538.256
1989	43.221	43.861	43.783	663.439	537.556	552.804
1990	44.745	43.597	43.736	647.707	527.787	542.343
1991	46.45	43.964	44.265	657.799	528.616	544.251
1992	47.791	44.157	44.602	664.075	545.269	559.817
1993	49.474	45.178	45.704	705.297	559.302	577.198
1994	51.091	46.058	46.676	706.617	569.144	586.022
1995	50.378	45.445	46.052	727.567	579.814	597.991
1996	48.346	45.861	46.169	774.834	597.911	619.815
1997	50.828	45.208	45.906	795.613	616.29	638.565

Date	PcLT	PcNLT	PcGB	OCLT	OCNLT	OCGB
1953	100	100	100	8.096	4.515	4.928
1954	97.642	97.642	97.642	8.313	4.636	5.06
1955	94.267	94.267	94.267	9.071	5.059	5.521
1956	96.847	96.847	96.847	9.345	5.212	5.688
1957	98.443	98.443	98.443	9.986	5.569	6.078
1958	94.552	94.552	94.552	9.769	5.448	5.946
1959	95.39	95.39	95.39	10.122	5.645	6.161
1960	92.238	92.238	92.238	10.548	5.882	6.42
1961	90.385	90.385	90.385	10.856	6.054	6.608
1962	85.725	85.725	85.725	10.806	6.026	6.577
1963	82.406	82.406	82.406	11.527	6.428	7.016
1964	79.651	79.651	79.651	11.532	6.431	7.019
1965	79.028	79.028	79.028	12.4	6.915	7.547
1966	76.856	76.856	76.856	12.694	7.079	7.726
1967	76.371	76.371	76.371	13.012	7.256	7.92
1968	78.144	78.144	78.144	14.113	7.87	8.59
1969	76.896	76.896	76.896	13.933	7.77	8.481
1970	76.307	76.307	76.307	15.014	8.373	9.138
1971	76.414	76.414	76.414	15.444	8.612	9.4
1972	74.645	74.645	74.645	15.44	8.61	9.398
1973	72.514	72.514	72.514	16.435	9.165	10.004
1974	67.341	67.341	67.341	16.416	9.155	9.992
1975	70.38	70.38	70.38	18.27	10.189	11.121
1976	68.229	68.229	68.229	17.577	9.802	10.699
1977	67.3	67.3	67.3	16.684	9.304	10.155
1978	67.197	67.197	67.197	17.24	9.614	10.494
1979	70.082	70.082	70.082	16.579	9.246	10.091
1980	69.966	69.966	69.966	17.327	9.663	10.546
1981	69.96	69.96	69.96	17.071	9.52	10.391
1982	68.024	68.024	68.024	17.531	9.776	10.67
1983	69.657	69.657	69.657	17.718	9.881	10.784
1984	67.865	67.865	67.865	16.897	9.423	10.285
1985	67.299	67.299	67.299	17.005	9.483	10.35
1986	64.284	64.284	64.284	15.707	8.328	9.171
1987	65.641	65.641	65.641	14.877	7.084	7.995
1988	65.573	65.573	65.573	14.855	6.752	7.717
1989	63.88	63.88	63.88	14.05	6.444	7.338
1990	62.311	62.311	62.311	13.656	6.215	7.032
1991	63.685	63.685	63.685	12.978	6.025	6.875
1992	64.545	64.545	64.545	12.062	5.733	6.552
1993	66.808	66.808	66.808	10.995	5.498	6.231
1994	66.784	66.784	66.784	9.948	5.368	5.94
1995	65.689	65.689	65.689	9.204	5.26	5.744
1996	66.827	66.827	66.827	9.461	5.001	5.474
1997	67.765	67.765	67.765	9.044	4.765	5.353

Date	PbLT	PbNLT	PbGB	SUBLT	SUBNLT	SUBGB
1953	100	100	100	0	0	0
1954	103.143	99.214	100.098	0	0	0
1955	106.203	99.624	100.47	0	0	0
1956	106.306	100.901	102.613	0	0	0
1957	109.862	108.997	108.91	0	0	0
1958	106.454	107.293	107.209	0	0	0
1959	108.969	109.807	109.723	0	0	0
1960	118.91	110.652	113.047	0	0	0
1961	124.199	112.981	116.106	0	0	0
1962	126.247	113.738	117.345	0	0	0
1963	127.218	116.617	119.699	0	0	0
1964	143.532	118.314	124.637	0	0	0
1965	137.153	123.264	127.292	0	0	0
1966	145.084	123.679	129.164	0	0	0
1967	141.58	129.896	133.747	0	0	0
1968	148.941	128.518	134.06	0	0	0
1969	165.699	128.555	137.441	0.085	0.042	0.048
1970	183.037	142.603	152.392	0.501	0.196	0.234
1971	167.652	147.733	153.948	0.64	0.233	0.284
1972	174.692	142.275	150.379	1.023	0.383	0.463
1973	160.052	139.166	145.245	1.476	0.549	0.661
1974	138.052	140.974	143.67	5.061	1.598	2.009
1975	164.251	161.715	165.7	9.558	2.901	3.673
1976	178.198	154.428	161.678	8.078	2.592	3.251
1977	179.808	150.86	158.387	7.213	2.196	2.812
1978	182.618	156.462	163.749	7.751	2.397	3.041
1979	182.766	160.182	161.674	7.238	2.747	3.277
1980	213.953	168.841	175.331	8.621	2.992	3.686
1981	203.858	160.824	176.464	7.356	3.569	4.066
1982	232.8	168.621	187.946	12.497	3.698	4.803
1983	227.006	168.115	190.12	12.781	3.57	4.719
1984	198.035	166.686	184.95	13.155	3.542	4.754
1985	207.336	164.007	183.671	8.345	3.414	4.062
1986	212.735	175.806	195.225	6.826	2.924	3.426
1987	213.936	178.454	197.814	6.564	2.288	2.792
1988	226.266	178.769	199.99	6.329	2.149	2.648
1989	231.376	178.441	200.483	5.149	2.031	2.404
1990	233.314	179.377	201.562	5.46	1.968	2.402
1991	241.398	184.233	207.277	6.112	1.924	2.456
1992	250.51	187.194	211.243	5.776	1.85	2.365
1993	266.266	191.306	217.387	5.578	1.743	2.252
1994	275.136	194.84	222.13	5.388	1.704	2.199
1995	279.585	196.962	224.775	5.313	1.683	2.171
1996	284.62	202.595	230.551	5.414	1.639	2.129
1997	286.156	207.849	235.511	5.013	1.596	2.066

APPENDIX 5

An Alternative Estimation Strategy

The simple price-markup relationship in equation (6) of Chapter six is estimated on the basis of a relatively small number of observations. This makes it inadvisable to conduct causality tests on the variables *Pb* and *SUB*, since the sensitivity of such tests to the size of the lag order will be even more pronounced in small samples. The focus of this section is to gain an insight into the nature of the direction of causation between public transport subsidy and bus fares in the price-markup equation, using all the data from 1953-97. This implies that *PS* and *CF* are given the value of zero for 1953-68. Although this increases the number of observations available for estimation, it also has the effect of pushing the estimated coefficients for *PS* and *CF* towards zero. This should be borne in mind when evaluating the following results. It also implies that these coefficient values should not be used for policy analysis.

As with the demand equation, system estimation of the price-markup equation produces unsatisfactory results. Single equation estimation via the ARDL method, on the other hand, gives results that are more satisfactory. In order to save degrees of freedom and improve the precision of the coefficient estimates, the *CF* variable is subtracted from the *OC* variable to generate an adjusted operating cost variable *OCA*. The modified form of equation (2) becomes:

$$Pb_t = \beta_0 + \beta_1 PS_t + \beta_2 OCA_t + \beta_3 F_t + \beta_4 DU + \beta_5 DU1 + u_2 \qquad \text{(A1)}$$

where *DU1* (1985=1, zero elsewhere) is included to control for the effects of ending low fares policies in the former metropolitan areas. The expected signs for β_1 and β_2 are negative and positive respectively. Since *F* measures the relative increase in the number of smaller, lower cost vehicles used by bus operators, the expected sign on β_3 is negative. *DU* now measures the competitive effects of deregulation only, since *PS*

controls for subsidy withdrawal, so the expected sign for β_4 is negative. β_5 is expected to be positive. Estimation is conducted within a log-linear specification, so that $\ln PS$ and $\ln CF$ are set equal to zero for 1953-68. Using an ARDL model with maximum lag order equal to two, and choosing the preferred specification by means of the SBC, the following ARDL(2,0,2,0) model is selected:

$$\begin{aligned}\ln Pb_t = {} & \underset{(9.471)}{7.317} + \underset{(1.764)}{0.209}\ln Pb_{t-1} - \underset{(-5.896)}{0.702}\ln Pb_{t-2} - \underset{(-2.478)}{0.008}\ln PS_t + \underset{(3.556)}{0.248}\ln OCA_t \\ & - \underset{(-4.681)}{0.506}\ln OCA_{t-1} + \underset{(4.089)}{0.363}\ln OCA_{t-2} - \underset{(-2.969)}{0.144}\ln F_t \\ & - \underset{(-2.427)}{0.067}DU - \underset{(-4.553)}{0.092}DU1 + \underset{(9.582)}{0.024}T \end{aligned} \qquad \text{(A2)}$$

$$\overline{R}^2 = 0.993 \quad \chi^2_{sc}(1) = 2.454 \quad \chi^2_{ff}(1) = 2.502 \quad \chi^2_{nm}(2) = 0.513 \quad \chi^2_{he}(1) = 0.674$$

All the coefficients are statistically significant at the ten per cent level or better, and there are no problems with the diagnostic tests. The positive time trend is consistent with the problems facing the bus industry from the 1950s onwards, namely the link between increasing car ownership, decreasing bus use and the consequent necessity on the part of bus operators to increase fares. One might expect a positive coefficient on *DU1*, but given its obvious statistical significance it is retained in the model specification. The ECM from the ARDL(2,0,2,0) model is:

$$\begin{aligned}\Delta\ln Pb_t = {} & \underset{(9.471)}{7.317} + \underset{(5.896)}{0.702}\Delta\ln Pb_{t-1} - \underset{(-2.478)}{0.008}\Delta\ln PS_t + \underset{(3.556)}{0.248}\Delta\ln OCA_t - \underset{(-4.089)}{0.363}\Delta\ln OCA_{t-1} \\ & - \underset{(-2.970)}{0.144}\ln F - \underset{(-2.427)}{0.067}DU - \underset{(-4.553)}{0.092}DU1 + \underset{(9.582)}{0.024}T - \underset{(-9.845)}{1.493}(CR)_{t-1} \end{aligned} \qquad \text{(A3)}$$

All the coefficients in the ECM are statistically significant, but there are two problems with the estimation results. First, the implied short run elasticity of *OCA* with respect to *Pb* is negative rather than positive. Second, the error correction coefficient is negative but

greater than unity, implying that the "correction" is taking *lnPb* further away from its long run equilibrium value. On the other hand, the model does a good job of tracking $\Delta \ln Pb$, with $\overline{R}^2 = 0.753$ and all the residuals falling within the two standard error band. From 1986 onwards most of the residuals fall within the one standard error band. The long run "equilibrium" relationship in the cointegration relationship *CR* is:

$$\ln Pb_t = \underset{(35.382)}{4.902} - \underset{(-2.482)}{0.006}\ln PS_t + \underset{(3.518)}{0.071}\ln OCA_t - \underset{(-3.175)}{0.097}\ln F - \underset{(-2.355)}{0.045}\ln DU - \underset{(-4.338)}{0.062}DU1$$

$$+ \underset{(21.843)}{0.016}T \qquad \text{(A4)}$$

All the long run coefficients are statistically significant and, with the exception of *DUI*, have the expected sign.

The F-test procedure (Pesaran and Pesaran, *op. cit.*, pp. 304-6) shows that we can easily reject the null hypothesis that the levels variables do not enter significantly into the equation for $\Delta \ln Pb$ i.e. $\ln Pb$ can be regarded as endogenous. This is not the case for the other explanatory variables, so that they are interpreted as the "long-run forcing" variables. This result is confirmed by using the Granger non-causality test within a VAR(4) model specification, where a fourth order lag is chosen by the AIC and SBC. The likelihood-ratio test for the null hypothesis that $\ln Pb$ does not Granger cause $\ln PS$ yields a $\chi^2(4)$ value of 3.634, compared to the critical $\chi^2(4)$ value at the 5 per cent level of significance of 9.488. In this case the null hypothesis cannot be rejected. Repeating the procedure for the null hypothesis that $\ln PS$ does not Granger cause $\ln Pb$, a $\chi^2(4)$ value of 21.680 is obtained. The null hypothesis is clearly rejected. The implication of these results is that it is changes in subsidy which Granger cause changes in bus fares, not *vice versa*. This form of the test may not be valid, however, because the VAR contains $I(1)$ variables. Canova (1995, p. 104) suggests using a VAR in first differences or a cointegrating VAR. Since it is difficult to generate a cointegrating VAR model which yields sensible and significant coefficient estimates, a first difference VAR

is used. The result of this form of the Granger non-causality test also strongly suggests uni-directional causality from subsidy to bus fares.

To summarise, the combination of first differenced and levels variables in equation (A3) appears to give a good fit to the data. The derived long-run relationship in equation (A4), although not strictly interpretable as an equilibrium relationship, is statistically significant. Crucially, both ARDL and VAR models of the price-markup relationship support the existence of uni-directional Granger causation from subsidy to bus fares.

References for Appendix 5

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